

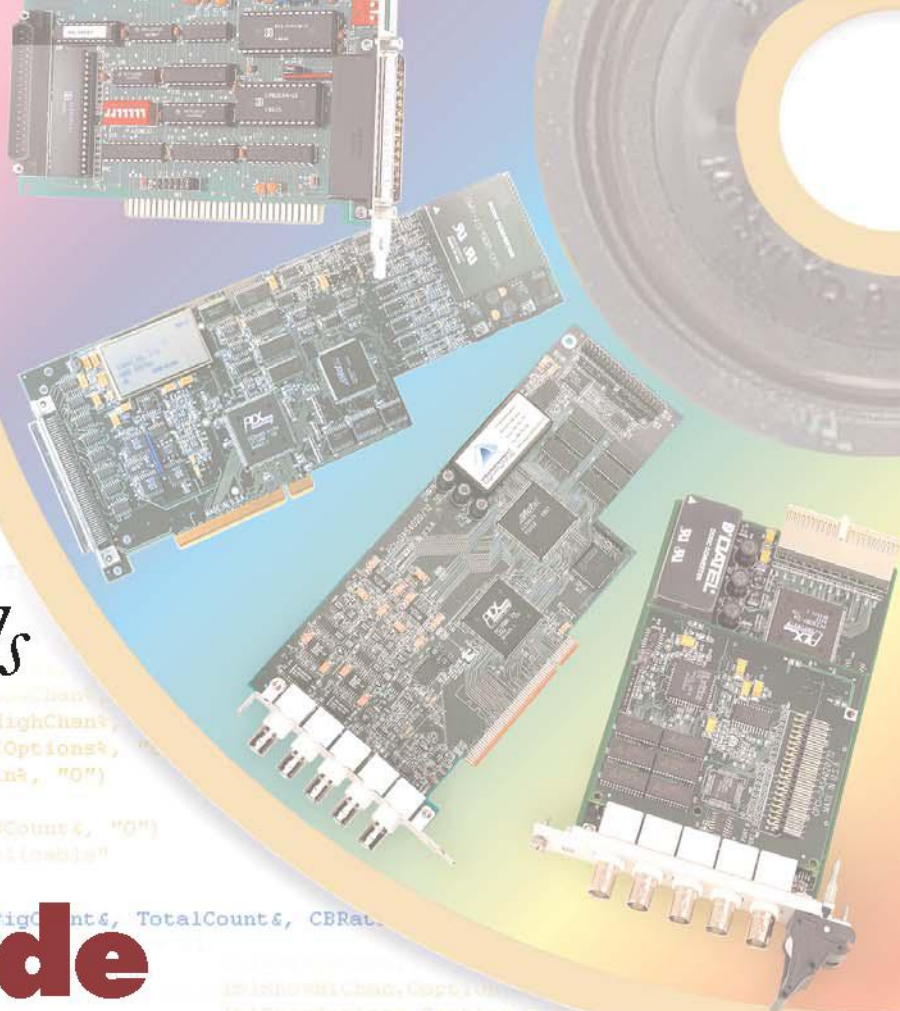
```
txtFileName.SetFocus  
Exit Sub  
ElseIf ULStat% <> 0 Then  
Stop
```

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Data Acquisition and Control Programming Tools

User's Guide

```
how many data points were collected  
% = cbFileGetInfo(fileName$, LowChan%, HighChan%, PreTrigCounts, TotalCount%, CBRate%)  
ULStat% <> 0 Then  
dRate.Capti  
dLoChan.C  
dHiChan.Capti  
Options% =  
dGain.Capti  
dFile.Capti  
dTotal.Capti  
dPreTrig.Capti  
ataCount% = Format$(NumPoints%, "0")  
olAcqStat.Capti  
olShowRate.Capti  
olShowHiChan.Capti  
olShowOptions.Capti  
olShowGain.Capti  
olShowFile.Capti
```



Universal Library™

User's Guide



**MEASUREMENT
COMPUTING™**

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Table of Contents

1	Introducing the Universal Library	10
	Universal Library overview	10
2	Installation and Configuration.....	12
	Installing the Universal Library	12
	The CB.CFG file and <i>InstaCal</i>	12
	Installation – .NET support.....	12
	Licensing information	12
	Redistributing a custom UL application	12
	Distributing <i>InstaCal</i> in addition to your custom UL application.....	13
	Integrating <i>InstaCal</i> into your custom UL installation CD or disk.....	13
3	Getting Started	14
	Example programs	14
4	Universal Library Description and Use.....	15
	General UL language interface description	15
	Function arguments.....	15
	Constants	15
	Options arguments.....	15
	Error handling.....	16
	16-bit values using a signed integer data type	16
	Using the Universal Library in Windows.....	16
	Real-time acquisition under Windows	16
	Processor speed	16
	Visual Basic for Windows	17
	Microsoft Visual C++	17
	Borland C /C++ for Windows	17
	Delphi example programs	18
5	Universal Library for .NET Description & Use	19
	Configuring a UL for .NET project.....	19
	General UL for .NET language interface description.....	20
	MccBoard class	20
	ErrorInfo class	21
	MccService class	22
	GlobalConfig class	22
	DataLogger Class.....	22
	MccDaq enumerations	23
	Parameter data types	25
	Differences between the UL and UL for .NET	25
	Board number	25
	MCC classes	26
	Methods	26
	Enumerated types	26
	Error handling.....	27
	Service methods	27
	Configuration methods	27
	Data Logger methods.....	28
6	Analog Input Boards	29
	Introduction	29
	Trigger support.....	29
	Digital trigger	29
	Analog trigger	29
	Pretrigger implementations	30
	Sampling rate using SINGLEIO	30

PCI-2500 Series.....	31
PCI-DAS6000 Series	38
PCI-DAS4020 Series	44
PCI-DAS64/Mx/16 Series.....	49
PCI- and CIO-DAS6402 and DAS3202 Series.....	52
PCI-DAS1602, PCI-DAS1200 & PCI-DAS1000 Series	56
PCIM-DAS1602 and PCIM-DAS16JR Series.....	60
CIO-DAS800 Series.....	63
CIO-, PCI-, and PC104-DAS08 Series.....	65
CIO-DAS08/Jr and CIO-DAS08/Jr/16 Series	68
PCM-DAS08	70
PPIO-AI08.....	71
CIO- and PC104-DAS16.....	72
PCM- and PC-CARD-DAS16 Series.....	76
CIO-DAS1400 and CIO-DAS1600 Series	79
CIO-DAS48/PGA	82
miniLAB 1008.....	83
USB-1208 Series	87
USB-1408 Series	92
USB-1608FS	96
USB-1608HS, USB-1608HS-2AO.....	99
USB-1616FS.....	103
USB-1616HS, USB-1616HS-2, and USB-1616HS-4	107
USB-1616HS-BNC.....	114
USB-2500 Series	120
DEMO-BOARD	127
7 Analog Output Boards	129
Introduction	129
DAC04 HS Series	130
DAC Series (Excluding HS Series)	131
PCI-DAC6700 Series.....	132
PCM- and PC-CARD- DAC Series.....	133
PCIM- and CIO- DDA06 Series.....	134
PCI- and CPCI- DDA Series	135
cSBX-DDA04	136
USB-3100 Series	137
8 Digital Input/Output Boards.....	140
Introduction	140
Basic signed integers	140
AC5 Series.....	141
DIO Series	142
DIO24/CTR3 and D24/CTR3 Series	143
PCI-DIO48/CTR15	144
PCIe-DIO24 and PCIe-DIO96H	145
PDISO8 and PDISO16 Series.....	146
Establishing and requesting control of an E-PDISO16.....	146
Sending a request for control of an E-PDISO16.....	147
Receiving a request for control of an E-PDISO16	147
Receiving a message	147
CIO-PDMA16 and CIO-PDMA32	148
USB-1024 and USB-DIO24 Series	149
USB-DIO96 Series (formerly USB-1096 Series).....	151
USB-SSR Series.....	153
Switch & Sense 8/8.....	154
DEMO-BOARD	155
9 Digital Input Boards	157
Introduction	157
CIO- and PC104- DI Series.....	158
CIO-DISO48.....	159

10 Digital Output Boards	160
Introduction	160
CIO-RELAY Series	161
USB-ERB Series.....	162
CIO- and PC104-DO Series.....	163
11 Counter Boards	164
Introduction	164
Visual Basic signed integers	164
Counter chip variables.....	164
CTR Series	165
INT32 Series	167
PPIO-CTR06.....	168
QUAD Series	169
USB-4300 Series	171
12 Expansion Boards	173
Introduction	173
AI-EXP48	174
CIO-EXP Series	175
MEGA-FIFO	176
13 MetraBus Boards.....	177
Introduction	177
MDB64 Series.....	178
MIO and MII Digital I/O	179
MEM Series Relay	180
MSSR-24 SSR	181
14 Temperature Input Boards.....	182
Introduction	182
CIO-DAS-TEMP	183
DAS-TC Series	184
USB-TEMP Series, USB-TC Series.....	185
USB-5203, USB-5201	188
WEB-TEMP, WEB-TC	191
WLS Series	195
15 Other Hardware	200
Introduction	200
COM422 Series	201
COM485 Series	201
Appendix – Measurement Computing Device IDs	202

Table of MCC Hardware with UL Support

CPCI boards

CPCI-DIO24H	142
CPCI-DIO48H	142
CPCI-DIO96H	142

Ethernet boards

E-PDISO16	146–47
-----------------	--------

Expansion boards

AI-EXP48	174
CIO-EXP16	175
CIO-EXP32	175
CIO-EXP-BRIDGE	175
CIO-EXP-GP	175
CIO-EXP-RTD	175
MEGA-FIFO	176

ISA boards

CIO-COM422	201
CIO-COM485	201
CIO-CTR05	165–66
CIO-CTR10	165–66
CIO-CTR10HD	165–66
CIO-CTR20HD	165–66
CIO-DAC02	131
CIO-DAC02/16	131
CIO-DAC04/12-HS	130
CIO-DAC04/16-HS	130
CIO-DAC08	131
CIO-DAC08/16	131
CIO-DAC08-I	131
CIO-DAC16	131
CIO-DAC16/16	131
CIO-DAC16-I	131
CIO-DAS08	65–67
CIO-DAS08/Jr	68
CIO-DAS08/Jr/16	68
CIO-DAS08/Jr/16-AO	68
CIO-DAS08/Jr-AO	68
CIO-DAS1401/12	79–81
CIO-DAS1402/12	79–81
CIO-DAS1402/16	79–81
CIO-DAS16	72–75
CIO-DAS16/330	72–75
CIO-DAS16/330i	72–75
CIO-DAS16/F	72–75
CIO-DAS16/Jr	72–75
CIO-DAS16/Jr/16	72–75
CIO-DAS16/M1	72–75
CIO-DAS16/M1/16	72–75
CIO-DAS1601/12	79–81
CIO-DAS1602/12	79–81
CIO-DAS1602/16	79–81
CIO-DAS48/PGA	82
CIO-DAS48-I	82
CIO-DAS6402/12	52–55
CIO-DAS6402/16	52–55
CIO-DAS800	63–64
CIO-DAS801	63–64
CIO-DAS802	63–64

CIO-DAS802/16	63–64
CIO-DAS-TC	184
CIO-DAS-TEMP	183
CIO-DI192	158
CIO-DI48	158
CIO-DI96	158
CIO-DIO192	142
CIO-DIO24	142
CIO-DIO24/CTR3	143
CIO-DIO24H	142
CIO-DIO48	142
CIO-DIO48H	142
CIO-DIO96	142
CIO-DISO48	159
CIO-DO192H	163
CIO-DO24DD	163
CIO-DO48DD	163
CIO-DO48H	163
CIO-DO96H	163
CIO-DUAL422	201
CIO-DUAL-AC5	141
CIO-INT32	167
CIO-PDISO16	146–47
CIO-PDISO8	146–47
CIO-PDMA16	148
CIO-PDMA32	148
CIO-QUAD02	169–70
CIO-QUAD04	169–70
CIO-RELAY08	161
CIO-RELAY16	161
CIO-RELAY16/M	161
CIO-RELAY24	161
CIO-RELAY32	161
Demo-Board	127–28, 155–56
ISA-MDB64	178

Life support

devices/systems	4
-----------------------	---

Memory boards

MEGA-FIFO	176
-----------------	-----

MetraBus boards

MEM-32	180
MEM-8	180
MSSR-24	181

PC104 boards

PC104-AC5	141
PC104-CTR10HD	165–66
PC104-DAC06	131
PC104-DAS08	65–67
PC104-DAS16Jr/12	72–75
PC104-DAS16Jr/16	72–75
PC104-DI48	158
PC104-DIO48	142
PC104-DO48H	163
PC104-MDB64	178
PC104-PDISO8	146–47

PCI boards

PCI-2511	31–37
PCI-2513	31–37
PCI-2515	31–37
PCI-2517	31–37
PCI-CTR05	165–66
PCI-CTR10	165–66
PCI-CTR20HD	165–66
PCI-DAC6702	132
PCI-DAC6703	132
PCI-DAS08	65–67
PCI-DAS1000	56–59
PCI-DAS1001	56–59
PCI-DAS1002	56–59
PCI-DAS1200	56–59
PCI-DAS1200/JR	56–59
PCI-DAS1602/12	56–59
PCI-DAS1602/16	56–59
PCI-DAS3202/16	52–55
PCI-DAS4020/12	44–48
PCI-DAS6013	38–43
PCI-DAS6014	38–43
PCI-DAS6023	38–43
PCI-DAS6025	38–43
PCI-DAS6030	38–43
PCI-DAS6031	38–43
PCI-DAS6032	38–43
PCI-DAS6033	38–43
PCI-DAS6034	38–43
PCI-DAS6035	38–43
PCI-DAS6036	38–43
PCI-DAS6040	38–43
PCI-DAS6052	38–43
PCI-DAS6070	38–43
PCI-DAS6071	38–43
PCI-DAS6402/12	52–55
PCI-DAS6402/16	52–55
PCI-DAS-TC	184
PCI-DIO24	142
PCI-DIO24/LP	142
PCI-DIO24/S	142
PCI-DIO24H	142
PCI-DIO24H/CTR3	143
PCI-DIO48H	142
PCI-DIO48H/CTR15	144–46
PCI-DIO96	142
PCI-DIO96H	142
PCI-DUAL-AC5	141
PCI-INT32	167
PCIM-DAS1602/16	60–62
PCIM-DAS16JR/16	60–62
PCI-MDB64	178
PCI-PDISO16	146–47
PCI-PDISO8	146–47
PCI-QUAD04	169–70
PCI-QUAD-AC5	141

PCIe boards

PCIe-DIO24.....	145
PCIe-DIO96H.....	145

PCMCIA cards

PC-CARD-D24/CTR3.....	143
PC-CARD-DAS16/12.....	76–78
PC-CARD-DAS16/12AO.....	76–78
PC-CARD-DAS16/16.....	76–78
PC-CARD-DAS16/16AO.....	76–78
PC-CARD-DAS16/330.....	76–78
PC-CARD-DIO48.....	142
PCM-D24/CTR3.....	143
PCM-DAS08.....	70
PCM-DAS16D/12.....	76–78
PCM-DAS16D/12AO.....	76–78
PCM-DAS16D/16.....	76–78
PCM-DAS16S/12.....	76–78
PCM-DAS16S/16.....	76–78
PCM-DAS16S/330.....	76–78
PCM-QUAD02.....	169–70

PPIO boards

PPIO-AI08.....	71
PPIO-CTR06.....	168
PPIO-DIO24.....	142

USB devices

miniLAB 1008.....	83–86
Switch & Sense 8/8.....	154
USB-1024HLS.....	149–50

USB-1024LS.....	149–50
USB-1096HFS.....	151–52, See
USB-DIO96H.....	
USB-1208FS.....	87–91
USB-1208LS.....	87–91
USB-1408FS.....	92–95
USB-1608FS.....	96–98
USB-1608HS.....	99–102
USB-1608HS-2AO.....	99–102
USB-1616FS.....	103–6
USB-1616HS.....	107–13
USB-1616HS-2.....	107–13
USB-1616HS-4.....	107–13
USB-1616HS-BNC.....	114–19
USB-2523.....	113–26
USB-2527.....	113–26
USB-2533.....	113–26
USB-2537.....	113–26
USB-3101.....	137–39
USB-3102.....	137–39
USB-3103.....	137–39
USB-3104.....	137–39
USB-3105.....	137–39
USB-3106.....	137–39
USB-3110.....	137–38
USB-3112.....	137–38
USB-3114.....	137–38
USB-4301.....	171–72

USB-4302.....	171–72
USB-4303.....	171–72
USB-4304.....	171–72
USB-5201.....	188–99
USB-5203.....	188–99
USB-DIO24/37.....	149–50
USB-DIO24H/37.....	149–50
USB-DIO96H.....	151–52
USB-DIO96H/50.....	151–52
USB-ERB08.....	162
USB-ERB24.....	162
USB-PDISO8.....	146–47
USB-PDISO8/40.....	146–47
USB-SSR08.....	153
USB-SSR24.....	153
USB-TC.....	185–87
USB-TC-AI.....	185–87
USB-TEMP.....	185–87
USB-TEMP-AI.....	185–87

Web devices

WEB-TC.....	191–94
WEB-TEMP.....	191–94

Wireless devices

WLS-IFC.....	195–99
WLS-TC.....	195–99
WLS-TEMP.....	195–99

Introducing the Universal Library

Congratulations and thank you for selecting the Universal Library (UL). We believe it is the most comprehensive and easiest-to-use data acquisition software interface available anywhere. As easy as Universal Library is to use, significant documentation and explanation is still required to help new users get going, and to allow previous users to take advantage of all the package's powerful features.

The fast changing nature of the software industry makes it very difficult to provide a totally up to date user guide in written form. Adding to this complexity are the new features and functions that are constantly being added to the library. To provide the most complete information possible and at the same time keep the information current, the Universal Library documentation is offered in four parts:

- **Universal Library User's Guide:** The User's Guide provides a general description of the UL, offers an overview of the various features and functions, and discusses and how they can be used in different operating systems and languages. The User's Guide also provides board-specific information relating to the features and functions that are included with the Universal Library.
- **Universal Library Function Reference:** The Function Reference contains detailed information about the Universal Library functions, usage, and options. This document is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.
- **Example programs:** The examples programs demonstrate the use of many of the most frequently used functions, and are valuable learning tools. They are written for many popular languages. Each example program is fully functional, and provides an ideal starting place for your own programming effort. You can cut and paste from the example programs to create your own programs. It's easier to cut-and-paste pieces from a known, working program than to start writing everything from scratch.
- **Readme files:** The best way to get the latest, most up to date information is through Readme files. We incorporate this information into our documentation as quickly as we can, but for the latest, greatest information, read the Readme file.

Universal Library overview

The Universal Library is the software that you need to write your own programs for use with any of Measurement Computing's data acquisition and control boards. The library is universal in three ways:

Universal across boards: The library contains high level functions for all of the common operations for all boards. Each of the boards has different hardware but the Universal Library hides these differences from your program. So, for example, a program written for use with one A/D board will work "as is" with a different A/D board.

Universal across languages: The Universal Library provides the identical set of functions and arguments for each supported language. If you switch languages, you will not have to learn a new library, with new syntax, and different features.

If you are programming for the .NET framework, you will find that the Universal Library for .NET has the same "look and feel" as the Universal Library for 32-bit windows applications, and is just as easy to program.

32-bit languages supported by the Universal Library at the time the library was released are listed in the following table.

Microsoft Windows Languages	.NET Languages	Borland Windows Languages
Visual Basic	VB .NET	Borland C++
Visual C/C++	C# .NET	Borland C++ Builder
Quick C for Windows		Delphi
Microsoft C		

Universal across platforms: The Universal Library provides the same sets of functions for Windows 2000, Windows XP, and Windows Vista. Additionally, these functions have been extended to support the .NET environment.

Windows Vista support

USB, PCI, WLS, and WEB devices are supported under Windows Vista. PCMCIA devices (PC-CARD and PCM hardware) are not supported under Windows Vista.

Installation and Configuration

Installing the Universal Library

To install the Universal Library, follow the steps below.

1. Place *the Measurement Computing Data Acquisition Software* CD in your CD drive.
The **MCC DAQ** dialog opens.
2. Select **InstaCal & Universal Library** and click the **Install** button.
3. Follow the installation instructions as prompted.

InstaCal is a powerful installation, test, and calibration software package that is installed with the Universal Library application. Refer to the *Quick Start Guide* for examples of using *InstaCal* with Measurement Computing's DEMO-BOARD.

The CB.CFG file and *InstaCal*

All board-specific information, including current installed options, is stored in the file CB.CFG file, which is read by Universal Library. *InstaCal* creates and/or modifies this file when board configuration information is added or updated. The Universal Library does not function without the CB.CFG file.

For this reason, you must use *InstaCal* to modify all board setups and configurations as well as to install or remove boards from your system.

Installation – .NET support

Universal Library support for .NET requires that the Microsoft .NET framework already be installed on the system before you install the Universal Library.

Licensing information

Each original copy of Universal Library is licensed for development use on one CPU at a time. It is theft to make copies of this program for simultaneous program development.

Redistributing a custom UL application

The easiest way to distribute an application written with the Universal Library is to include a copy of Measurement Computing's *InstaCal* installation package with the application. Instruct the end user to install *InstaCal* before installing the application.

Some developers may want to integrate the installation of the required Universal Library drivers into the custom application's installation. This should only be attempted by developers experienced in installation development.

Following is an overview of the two methods.

Distributing *InstaCal* in addition to your custom UL application

If you create an application using the Universal Library, you may distribute the necessary runtime files (Universal Library driver files) with the application royalty free. These files can be installed from Measurement Computing's *InstaCal* installation package. To distribute a custom UL application, provide the end user with two CDs or disks:

- One CD or disk that contains Measurement Computing's *InstaCal* application. *InstaCal* must be installed before the custom UL application.
- One CD or disk that contains the setup program for their custom VB or C++ application.

You may not distribute any files that give the end user the ability to develop applications using the Universal Library.

Integrating *InstaCal* into your custom UL installation CD or disk

For developers who wish to distribute their application on one CD, refer to the *Universal Library Redistribution Guide*. This document contains procedures to merge the setup programs for both *InstaCal* and the custom UL application into one setup program that you can distribute on one CD or disk. The merging process is complicated — only experienced programmers should attempt to do this.

When you install the software, the *Universal Library Redistribution Guide* (ULRedistribution.pdf) is copied to the default installation directory "C:\Program Files\Measurement Computing\DAQ\Documents" on your local drive.

Getting Started

The Universal Library is callable from many languages and environments, including Visual Basic®, Visual C++, Borland C++ Builder, and Delphi. A list of the languages currently supported by the Universal Library is provided on page 11. Additionally, the UL is now callable from any language supported by the .NET framework. This chapter describes how to use the library from each of the languages. The first section of the chapter describes details of the library that apply to all languages. The following sections describe the differences for each language.

Before starting your application, you should perform the following:

- Set up and test your boards with *InstaCal*. The Universal Library will not function until *InstaCal* has created a configuration file (CB.CFG).
- Run the example programs for the language you program in.

Example programs

You can install example programs for supported languages when you install the Universal Library software. If selected, the example programs are installed into the following installation subdirectories:

- C
- C#
- CWIN
- DELPHI
- VB.NET
- VBWIN

On Windows 2000 and Windows XP, the example programs are installed by default to \Program Files\Measurement Computing\DAQ.

On Windows Vista, the example programs are installed by default to \Users\Public\Documents\Measurement Computing\DAQ. When you install the example programs, an "Examples" shortcut is added to the directory where you installed the Universal Library software. When selected, the directory containing the example programs opens in Windows Explorer.

For a complete list of example programs, refer to the Universal Library Function Reference

The *Universal Library Function Reference* contains tables that list the UL and UL for .NET example programs. Each table contains the name of the sample program and the functions that the program demonstrates. This document is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.

Universal Library Description and Use

The Universal Library consists of a set of functions that are callable from your program. These functions are grouped according to their purpose. All of the groups except for *Miscellaneous* are based on which type of device they are used with.

Important - Read the UL documentation, Readme file, and run the example programs

In order to understand the functions, please read the board-specific information section contained in this manual and in the Readme files supplied on the Universal Library disk. We also urge you to examine and run one or more of the example programs supplied prior to attempting any programming of your own. Following this advice can save you hours of frustration and wasted time.

General UL language interface description

The interface to all languages is a set of function calls and a set of constants. The list of function calls and constants are identical for each language. All of the functions and constants are defined in a "header" file for each language. Refer to the sections below, and especially to the example programs for each language. This manual is brief with respect to details of language use and syntax. For more detailed information, review the example programs. Example programs for each language are located in the installation directory.

Function arguments

Each library function takes a list of arguments and most return an error code. Some functions also return data via their arguments. For example, one of the arguments to `cbAIn()` is the name of a variable in which the analog input value will be stored. All function arguments that return data are listed in the **"Returns"** section of the function description.

Constants

Many functions take arguments that must be set to one of a small number of choices. These choices are all given symbolic constant names. For example, `cbTIn()` takes an argument called `Scale` that must be set to `CELSIUS`, `FAHRENHEIT`, or `KELVIN`. These constant names are defined, and are assigned a value in the "header" file for each language. Although it is possible to use the numbers rather than the symbolic constant names, we strongly recommend that you use the names. Using constant names make your programs more readable and more compatible with future versions of the library. The numbers may change in future versions, but the symbolic names always remain the same.

Options arguments

Some library functions have an argument called `Options`. The `Options` argument is used to turn on and off various optional features associated with the function. If you set `Options = 0`, the function sets all of these options to the default value, or `OFF`.

Some options can have an alternative value, such as `DTCONNECT` and `NODTCONNECT`. If an option can have more than one value, one of the values is designated as the default. Individual options can be turned on by adding them to the `Options` argument. For example:

- `Options = BACKGROUND` will turn on the "background execution" feature.
- `Options = BACKGROUND+CONTINUOUS` will select both the "background execution" and the "continuous execution" feature.

Error handling

Most library functions return an error code. If no errors occurred during a library call, 0 (or NOERRORS) is returned as the error code. Otherwise, it is set to one of the codes listed in the *Universal Library Function Reference* "Error Codes" chapter. This document is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.

If a non-zero error code is returned, you can use `cbGetErrMsg()` to convert the error code to a specific error message. As an alternative to checking the error code after each function call, you can turn on the library's internal error handling with `cbErrHandling()`.

16-bit values using a signed integer data type

When using functions that require 16-bit values, the data is normally in the range of 0 to 65535. However, some programming languages such as Visual Basic only provide signed data types. When using signed integers, reading values above (32767) can be confusing.

The number (32767) in decimal is equivalent to (0111 1111 1111 1111) binary. The next increment (1000 0000 0000 0000) binary has a decimal value of (-32768). The maximum value (1111 1111 1111 1111) binary translates to (-1) decimal. Keep this in mind if you are using Visual Basic (up to version 6) or other languages that don't support unsigned integers.

There is additional information on this topic in the *Universal Library Function Reference*. This document is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf. Also, refer to the documentation supplied with your language compiler.

Using the Universal Library in Windows

All 32-bit applications (including console applications) access the 32-bit Windows Dynamic Link Library (DLL) version of the Universal Library (CBW32.DLL). Example programs that illustrate the use of CBW32.DLLs are provided for each supported language.

The Universal Library contains four functions for managing Windows global memory buffers:

- `cbWinBufAlloc()`
- `cbWinBufFree()`
- `cbWinArrayToBuf()`
- `cbWinBufToArray()`

Real-time acquisition under Windows

Real-time acquisition is available for Windows. To operate at full speed in Windows, the A/D board must have an onboard FIFO buffer. All of our advanced designs have FIFO buffers, including our PCI-DAS boards (except for the PCI-DAS08), and many of our CIO- boards, such as the CIO-DAS80x, CIO-DAS160x, CIO-DAS140x, and CIO-DAS16/330x. All of these data acquisition boards will operate at full speed in Windows.

Applying software calibration factors in real time on a per-sample basis eats up machine cycles. If your CPU is slow, or if processing time is at a premium, withhold calibration until after the acquisition run is complete. Turning off real-time software calibration saves CPU time during a high speed acquisition run.

Processor speed

Processor speed remains a factor for DMA transfers and for real-time software calibration. Processors of less than a 150 megahertz (MHz) Pentium class may impose speed limits below the capability of the board (refer to specific board information.)

If your processor is less than a 150 MHz Pentium and you need an acquisition speed in excess of 200 kilohertz (kHz), use the `NOCALIBRATEDATA` option to turn off real-time software calibration and save CPU time. After the acquisition is run, calibrate the data with `cbACalibrateData()`.

Visual Basic for Windows

To use the Universal Library with Visual Basic, include the Universal Library declaration file `CBW.BAS` in your program. Include the file as a module in the project, or include it by reference inside those Forms which call into the Universal Library. Once the declarations for the Universal Library have been added to your project, call the library functions from any Form's event handlers.

For Visual Basic 6.0 and older, Windows memory buffers cannot be mapped onto arrays. As a consequence, the `cbWinArrayToBuf()` and `cbWinBufToArray()` functions must be used to copy data between arrays and Windows buffers.

Example:

```
Count = 100
MemHandle = cbWinBufAlloc (Count)
cbAInScan (....., MemHandle,...)
cbWinBufToArray (MemHandle, dataArray(0), 0, Count)
For i = 0 To Count
    Print dataArray(i)
Next i
cbWinBufFree (MemHandle)
```

Visual Basic example programs

A complete set of Visual Basic example programs is included in the `VBWIN` folder of the Universal Library installation directory. Each program illustrates the use of a Universal Library function from within a Visual Basic program. The `.FRM` files contain the programs, and the corresponding `.VBP` files are the project files used to build the programs for Visual Basic.

Microsoft Visual C++

To use the Universal Library with MS Visual C++, include the Universal Library header file `CBW.H` in your C/C++ program and add the library file `CBW32.LIB` to your library modules for linking to the `CBW32.DLL`.

Microsoft Visual C++ example programs

The `CWIN` folder of the Universal Library installation directory contains three sample programs - `Wincai01`, `Wincai02` and `Wincai03`. Each program is an example of a simple C program that calls a few of the Universal Library functions from a Windows application. Use the `.DSP` project files to build a 32-bit application.

The non-Windows C examples in the `C` folder of the installation directory provide a more complete set of examples. You can compile these programs as 32-bit console applications for Windows by using the `MAKEMC32.BAT` file.

Borland C /C++ for Windows

For 32-bit Borland (or Inprise) C/C++ compilers, include the Universal Library header file `CBW.H` in your program and link with the import library file `CBW32BC.LIB`.

Borland C/C++ example programs

The non-Windows C examples provide an extensive set of examples. These can be compiled as 32-bit console applications using the `MAKEBC32.BAT` file.

Delphi example programs

A complete set of Delphi example programs is included in the DELPHI folder of the Universal Library installation directory. Each program illustrates the use of one Universal Library function from within a Delphi program. The .PAS files contain the programs. The corresponding .DPR file is the Project file used to build the program in a 32-bit Delphi environment.

In 32-bit Delphi environments use the `cbw32.dll` header. Where integers are passed by reference to a Universal Library function, use the `SmallInt` data type in 32-bit environments. The relevant functions are defined this way in the 32-bit header, so if you try to pass an `Integer` data type you will get a compiler error.

Universal Library for .NET Description & Use

Programming the Universal Library API is now available through the various languages supported by the Microsoft .NET framework. All .NET applications access the 32-bit Windows Universal Library (CBW32.DLL) through the MccDaq .NET assembly (MCCDAQ.DLL). The MccDaq assembly provides an interface that exposes each Universal Library function that is callable from the .NET language.

The Universal Library for .NET is designed to provide the same "look and feel" as the Universal Library for 32-bit Windows. This design makes it easier to port over existing data acquisition programs, and minimizes the learning curve for programmers familiar with the CBW32.DLL interface.

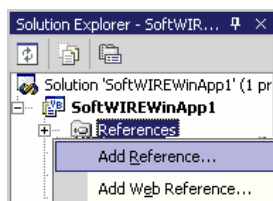
In the Universal Library for .NET, each function is exposed as a class method with virtually the same parameter set as their UL counterparts.

Configuring a UL for .NET project

In a .NET application, there are no header files to include in your project. You define methods and constants by adding the MccDaq assembly, or Namespace, as a reference to your project. You access UL for .NET methods through a class that has the Universal Library as a member.

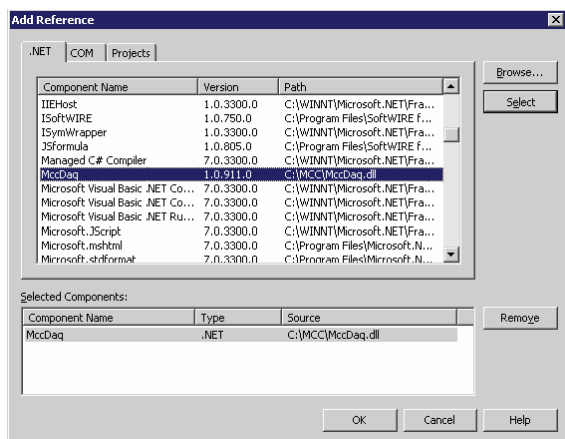
To add the MccDaq Namespace as a reference in a Visual Studio .NET project:

1. Start a new Visual Basic or C# project in Visual Studio .NET.
2. From the Visual Studio .NET Solution Explorer window, right-click on **References** and select **Add Reference**.



The **Add Reference** window appears.

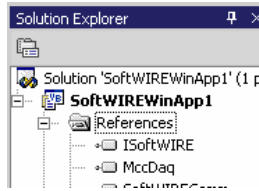
3. From the **.NET** tab, select the **MccDaq** option from the displayed list of .NET assemblies and click on the **Select** button.



MccDaq displays in the **Selected Components** area on the window.

4. Click on the **OK** button.

MccDaq appears under the **References** folder in the Solution Explorer window.



The MccDaq Namespace is now referenced by your Visual Studio .NET project.

General UL for .NET language interface description

The **MccDaq Namespace** provides an interface that exposes each Universal Library for .NET method as a member of a class with virtually the same parameters set as their UL counterparts. The MccDaq Namespace is a logical naming scheme for grouping related types. The .NET Framework uses a hierarchical naming scheme for grouping types into logical categories of related functionality.

When you develop a .NET application that uses the Universal Library, you add the MccDaq Namespace as a reference to your project. There are no "header" files in a .NET project.

The MccDaq Namespace contains the classes and enumerated values by which UL for .NET applications access the Universal Library data types and functions. The MccDaq Namespace contains five main classes:

- MccBoard class
- ErrorInfo class
- MccService class
- GlobalConfig class
- DataLogger class

The MccDaq assembly allows you to design Common Language Specification (CLS)-compliant programs. A CLS-compliant program contains methods that can be called from any existing or future language developed for the Microsoft .NET framework. Use CLS-compliant data types to ensure future compatibility.

MccBoard class

The MccBoard class provides access to all of the methods for data acquisition and properties providing board information and configuration for a particular board.

Class Constructors

The MccBoard class provides two constructors; one which accepts a board number argument and one with no arguments.

The following code examples demonstrate how to create a new instance of the MccBoard class using the latter version with a default board number of 0:

Visual Basic	<pre>Private DaqBoard As MccDaq.MccBoard DaqBoard = New MccDaq.MccBoard()</pre>
C#	<pre>private MccDaq.MccBoard DaqBoard; DaqBoard = new MccDaq.MccBoard();</pre>

The following code examples demonstrate how to create a new instance of the `MccBoard` class with the board number passed to it:

Visual Basic	<pre>Private DaqBoard As MccDaq.MccBoard DaqBoard = New MccDaq.MccBoard(BoardNumber)</pre>
C#	<pre>private MccDaq.MccBoard DaqBoard; DaqBoard = new MccDaq.MccBoard(BoardNumber);</pre>

Class properties

The `MccBoard` class also contains six properties that you can use to examine or change the configuration of your board. The configuration information for all boards is stored in the `CB.CFG` file, and is loaded from `CB.CFG` by all programs that use the library.

Properties	Description
<code>BoardName</code>	Name of the board associated with an instance of the <code>MccBoard</code> class.
<code>BoardNum</code>	Number of the board associated with an instance of the <code>MccBoard</code> class.
<code>BoardConfig</code>	Gets a reference to a <code>cBoardConfig</code> class object. Use this class reference to get or set various board settings.
<code>CtrConfig</code>	Gets a reference to a <code>cCtrConfig</code> class object. Use this class reference to get or set various counter settings.
<code>DioConfig</code>	Gets a reference to a <code>cDioConfig</code> class object. Use this class reference to get or set various digital I/O settings.
<code>ExpansionConfig</code>	Gets a reference to a <code>cExpansionConfig</code> class object. Use this class reference to get or set various expansion board settings.

Class methods

The `MccBoard` class contains close to 80 methods that are equivalents of the function calls used in the standard Universal Library. The `MccBoard` class methods have virtually the same parameters set as their UL counterparts.

The following code examples demonstrate how to call the `AIn()` method of the `MccBoard` object `MccDaq`:

Visual Basic	<pre>ULStat = DaqBoard.AIn(Chan, Range, DataValue)</pre>
C#	<pre>ULStat = DaqBoard.AIn(Chan, Range, out DataValue);</pre>

Many of the arguments are `MccDaq` enumerated values. Enumerated values take settings such as range types or scan options and put them into logical groups. For example, to set a range value, reference a value from the `MCCDaq.Range` enumerated type, such as `Range.Bip5Volts`. Refer to Table 1 on page 23 for a list of `MccDaq` enumerated values.

The *Universal Library Function Reference* contains detailed information about all `MccBoard` class methods. This document is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.

ErrorInfo class

Most UL methods return `ErrorInfo` objects. These objects contain two properties that provide information on the status of the method called:

- `ErrorInfo.Message` property gets the text of the error message associated with a specific error code.
- `ErrorInfo.Value` property gets the named constant value associated with the `ErrorInfo` object.

The `ErrorInfo` class also includes error code enumerated values, which define the error number and associated message which can be returned when you call a method.

MccService class

The `MccService` class contains all members for calling utility UL functions. This class contains the following static methods (you do not need to create an instance of the `MccService` class to call these methods):

- `DeclareRevision()`
- `ErrHandling()`
- `FileGetInfo()`
- `FileRead()`
- `GetBoardName()`
- `GetRevision()`
- `WinArrayToBuf()`
- `WinBufAlloc()`
- `WinBufAlloc32()`
- `WinBufFree()`
- `WinBufToArray()`
- `WinBufToArray32()`

The following code examples demonstrate how to call a UL for .NET memory management method from within a Universal Library program:

```
WindowHandle=MccService.WinBuffAlloc(1000)
MccService.WinBuffFree(WindowHandle)
```

GlobalConfig class

The `GlobalConfig` class contains all of the members for getting global configuration information. This class contains three properties:

- `MccDaq.GlobalConfig.NumBoards` property returns the maximum number of boards that you can install at one time. `ConfigGlobal=MccDaq.GlobalConfig.NumBoards`
- `MccDaq.GlobalConfig.NumExpBoards` property returns the maximum number of expansions boards that are allowed to be installed on the board. `ConfigGlobal=MccDaq.GlobalConfig.NumExpBoards`
- `MccDaq.GlobalConfig.Version` property is used to determine compatibility with the library version. `ConfigGlobal=MccDaq.GlobalConfig.Version`

Each of these properties is typed as an Integer.

DataLogger Class

The `DataLogger` class contains all members for reading and converting the data contained in binary log files. This class contains one property and 14 methods:

- `FileName` property returns the file name associated with an instance of the `DataLogger` class.
- `ConvertFile()` converts a binary log file to a comma-separated values (.CSV) text file or another text file format that you specify.
- `GetAIChannelCount()` retrieves the total number of analog channels that were logged in a binary file.
- `GetAIInfo()` retrieves the channel number and unit value of each analog input channel logged in a binary file.
- `GetCJCInfo()` retrieves the number of CJC temperature channels logged in a binary file.
- `GetDIOInfo()` retrieves the number of digital I/O channels logged in a binary file.
- `GetFileInfo()` retrieves the version level and byte size of a binary file.

- `GetFileName()` retrieves the name of the n^{th} file in the directory containing binary log files.
- `GetPreferences` retrieves API preference settings for time stamp data, analog temperature data, and CJC temperature data. Returns the default values unless changed using `SetPreferences()`.
- `GetSampleInfo()` retrieves the sample interval, sample count, and the date and time of the first data point in a binary file.
- `ReadAIChannels()` retrieves analog input data from a binary file, and stores the values in an array.
- `ReadCJCChannels()` retrieves CJC temperature data from a binary file, and stores the values in an array.
- `ReadDIOChannels()` retrieves digital I/O channel data from a binary file, and stores the values in an array.
- `ReadTimeTags()` retrieves date and time values logged in a binary file. This method stores date values in the `dateTags` array, and time values in the `timeTags` array.
- `SetPreferences()` sets formatting preferences for returned time stamp data, analog data, and CJC temperature data.

The following code examples demonstrate how to use the `GetFileName()` method from within a Universal Library program to retrieve the name of a binary log file:

Visual Basic	<code>Status = DataLogger.GetFileName(MccService.GetFirst, path, filename)</code>
C#	<code>status = DataLogger.GetFileName(MccService.GetFirst, ref path, ref filename);</code>

MccDaq enumerations

The MccDaq Namespace contains enumerated values which are used by many of the methods available from the MccDaq classes (see Table 1). Refer to specific method descriptions in the Universal Library Function Reference for the values of each enumerated type. This document is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.

Table 1. MccDaq Enumerated Values

Enumeration Name	Description
MccDaq.BCDMode	Lists BCD mode options (enabled/disabled).
MccDaq.C8254Mode	Lists all of the operating modes for 8254 counters.
MccDaq.C8536OutputControl	Lists all of the types of output from an 8536 counters.
MccDaq.C8536TriggerType	Lists all of the options for specifying the trigger type for 8536 counters.
MccDaq.C9513OutputControl	List all of the types of output from a 9513 counters.
MccDaq.CompareValue	List all options for comparing values while configuring a 9513 counter.
MccDaq.ConnectionPin	Defines the connector pins to associate with the signal type and direction when calling the <code>SelectSignal()</code> method.
MccDaq.CounterControl	Defines the possible state of each counter channel (enabled/disabled).
MccDaq.CountDirection	Defines the count direction when configuring counters.
MccDaq.CountEdge	Defines the edge used for counting.
MccDaq.CounterRegister	Lists all of the register names used to load counters.
MccDaq.CounterSource	Lists all counter input sources.
MccDaq.CountingMode	Lists all valid modes for a C7266 counter configuration.
MccDaq.CtrlOutput	Lists all of the options for linking counter 1 to counter 2.
MccDaq.DACUpdate	Defines the available DAC update modes
MccDaq.DataEncoding	Lists the format of the data that is returned by a counter.
MccDaq.DigitalPortDirection	Configures a digital I/O port as input or output.
MccDaq.DigitalLogicState	Defines all digital logic states.
MccDaq.DigitalPortType	Defines all digital port types.
MccDaq.DTMode	Lists all modes to transfer to/from the memory boards.
MccDaq.ErrorHandling	Defines all error handling options.
MccDaq.ErrorInfo.ErrorCode	Defines all error constants.

Enumeration Name	Description
MccDaq.ErrorReporting	Defines all error reporting options.
MccDaq.EventType	Lists all available event conditions.
MccDaq.FieldDelimiter	Lists all options for specifying the delimiter character used to separate fields in a converted binary log file.
MccDaq.FlagPins	Lists all signals types that can be routed to the FLG1 and FLG2 pins on the 7266 counters.
MccDaq.FunctionType	List all valid function types used with data acquisition methods.
MccDaq.GateControl	List all of the gating modes for configuring a 9513 counter.
MccDaq.IndexMode	List the actions to be taken when the index signal is received by a 7266 counter.
MccDaq.LoggerUnits	Lists the options used to specify the units for analog data in a binary file
MccDaq.OptionState	Enables or disables various options.
MccDaq.PrimaryBitConfigPortType	Defines digital port types for bit level configuration.
MccDaq.PrimaryDigitalPortType	Defines digital port types for bit level input/output methods.
MccDaq.Quadrature	Lists all of the resolution multipliers for quadrature input.
MccDaq.Range	Defines the set of ranges within the UL for A/D and D/A operations.
MccDaq.RecycleMode	Lists the recycle mode options for 9513 and 8536 counters.
MccDaq.Reload	Lists the options for reloading the 9513 counter.
MccDaq.ScanOptions	List the available scan options for paced input/output methods.
MccDaq.SignalType	List all signal types associated with a connector pin on boards supporting a DAQ-Sync connector.
MccDaq.SignalDirection	Lists all of the directions available from a specified signal type assigned to a connector pin.
MccDaq.SignalPolarity	List all available polarities for a specified signal.
MccDaq.SignalSource	List all of the signal sources of the signal from which the frequency will be calculated.
MccDaq.SoftwareTriggerType	Defines trigger types for software triggering.
MccDaq.StatusBits	List all status bits available when reading counter status.
MccDaq.TempScale	Lists the options used to specify the units for analog data in a converted file.
MccDaq.TimeFormat	Lists all options for specifying the time format of timestamp data.
MccDaq.TimeOfDay	List all time of day options for initializing a 9513 counter.
MccDaq.TimeZone	Lists all options for specifying the time zone of timestamp data
MccDaq.TriggerType	List all valid trigger types for the MccBoard.SetTrigger method.
MccDaq.ThermocoupleOptions	Specifies whether or not to apply smoothing to temperature readings.

Parameter data types

Many of the Universal Library for .NET methods are overloaded to provide for signed or unsigned data types as parameters. The `AConvertData()` method is shown below using both signed and unsigned data types.

VB.NET	Public Function AConvertData(ByVal numPoints As Integer, ByRef adData As Short, ByRef chanTags As Short) As MccDaq.ErrorInfo Member of MccDaq.MccBoard
	Public Function AConvertData(ByVal numPoints As Integer, ByRef adData As System.UInt16, ByRef chanTags As System.UInt16) As MccDaq.ErrorInfo Member of MccDaq.MccBoard
C#.NET	public MccDaq.ErrorInfo AConvertData (System.Int32 numPoints, System.Int16 adData, System.Int16 chanTags) Member of MccDaq.MccBoard
	public MccDaq.ErrorInfo AConvertData (System.Int32 numPoints, System.UInt16 adData, System.UInt16 chanTags) Member of MccDaq.MccBoard

For most data acquisition applications, unsigned data values are easier to manage. However, since Visual Basic (version 6 and earlier) does not support unsigned data types, it may be easier to port these programs to .NET if the signed data types are used for the method parameters. For additional information on using signed data types, refer to the section "[16-bit values using a signed integer data type](#)" on page 16.

The short (Int16) data type is Common Language Specification (CLS) compliant, is supported in VB, and will be included in any future .NET language developed for the .NET framework. Using CLS-compliant data types ensures future compatibility. Unsigned data types are not CLS compliant, but are still supported by various .NET languages, such as C#.

Differences between the UL and UL for .NET

Table 2 lists the differences between the Universal Library and the Universal Library for .NET.

Table 2. Differences between UL and UL for .NET

	Universal Library	Universal Library for .NET
Board Number	The board number is included as a parameter to the board functions.	An MccBoard class is created for each board installed, and the board number is passed to that board class.
Functions	Set of function calls defined in a header.	Set of methods. Methods of MccBoard or MccService classes. To access a method, instantiate a UL for .NET class and call the appropriate method using that class.
Constants	Constants are defined and assigned a value in the "header" file.	Constants are defined as enumerated types.
Return value	The return value is an Error code.	The return value is an ErrorInfo object that contains the error's number and message.

Board number

In a .NET application, multiple boards may be programmed by creating an `MccBoard Class` object for each board installed:

```
Board0 = new MccBoard(0)
Board1 = new MccBoard(1)
Board2 = new MccBoard(2)
```

Note that the board number may be passed into the `MccBoard` class, which eliminates the need to include the board number as a parameter to the board methods.

MCC classes

To use board-specific Universal Library functions inside a .NET application, you use methods of the appropriate class. UL for .NET classes are listed in Table 3.

Table 3. UL for .NET Board Classes

UL for .NET Class	Description
MccBoard	Access board-related Universal Library functions.
ErrorInfo	Utility class for storing and reporting error codes and messages.
BoardConfig	Gets and sets board configuration settings.
CtrConfig	Gets and sets counter configuration settings.
DioConfig	Gets and sets digital I/O configuration settings.
ExpansionConfig	Gets and sets expansion board configuration settings.
GlobalConfig	Gets and sets global configuration settings.
MccService	Access utility Universal Library functions.
DataLogger	Reads and converts binary log files.

Refer to the *Universal Library Function Reference* (available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf) for additional class information.

Methods

Methods are accessed through the class containing them. The following example demonstrates how to call the `AIn()` method from within a 32-bit Windows application and also from a .NET application.

VB Application using CBW32.DLL	VB .NET Application using MCCDAQ.DLL
<pre>Dim Board As Integer Dim Channel As Integer Dim Range As Integer Dim ULStat As Integer Dim DataValue As Short Board = 0 Channel = 0 Range = BIP5VOLTS; ULStat = cbAIn(Board, Channel, Range, DataValue)</pre>	<pre>Dim Board0 As MccBoard Board0 = new MccDaq.MccBoard(0) Dim Channel As Integer Dim Range As MccDaq.Range Dim ULStat As ErrorInfo Dim DataValue As UInt16 Channel = 0 Range = Range.BIP5VOLTS; ULStat = Board0.AIn(Channel, Range, DataValue)</pre>

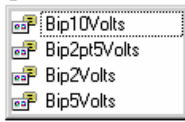
Enumerated types

Instead of using constants such as `BIP5VOLTS`, the Universal Library for .NET uses enumerated types. An enumerated type takes settings such as range types, scan options or digital port numbers and puts them into logical groups. Some examples are:

Range.Bip5Volts
Range.Bip10Volts
Range.Uni5Volts
Range.Uni10Volts
ScanOptions.Background
ScanOptions.Continuous
ScanOptions.BurstMode
TimeZone.GMT
FileType.Text

If you are programming inside of Visual Studio .NET, the types that are available for a particular enumerated value display automatically when you type code:

```
int Gain =Range.
```



Error handling

For .NET applications, the return value for the Universal Library functions is an object (ErrorInfo), rather than a single integer value. The ErrorInfo object contains both the numeric value for the error that occurred, as well as the associated error message. Within a .NET application, error checking may be performed as follows:

```
ULStat=Board0.AIn(Channel, Range, DataValue)
'check the numeric value of ULStat
If Not ULStat.Value = ErrorInfo.ErrorCode.NoErrors Then
    'if there was an error, then display the error message
    MsgBox ULStat.Message
EndIf
```

Service methods

You can access other Universal Library functions that are not board-specific through the MccService class. This class contains a set of static methods you can access directly, without having to instantiate an MccService object. The following examples demonstrate library calls to .NET memory management methods:

```
WindowHandle = MccService.WinBuffAlloc(1000)
MccService.WinBuffFree(WindowHandle)
```

Configuration methods

In 32-bit Windows applications, you access board configuration information by calling the cbGetConfig and cbSetConfig API functions. In .NET applications, you access board configuration information through separate classes, such as cBoardConfig, cCtrConfig, cDioConfig, and cExpansionConfig. Each configuration item has a separate get and set method.

Some examples of how to access board configuration within a .NET application are shown below:

- ULStat = Board0.BoardConfig.GetRange(RangeValue)
- ULStat = Board1.DioConfig.GetNumBits(DevNumber, Number)
- ULStat = Board2.CtrConfig.GetCtrType(DevNumber, CounterType)
- ULStat = Board3.BoardConfig.SetClock(ClockSource)
- ULStat = Board4.ExpansionConfig.SetCJCChan(DevNumber, CjcChan)

Data Logger methods

In 32-bit Windows applications, you access information contained in binary log files by calling the API functions. In .NET applications, you access this information by calling the `DataLogger` class and its methods.

The following example demonstrates how to retrieve the name of the first binary log file using the `cbLogGetFileName()` function and `GetFileName()` method.

C/C++ application	C# application
<pre>char filename(50); char* path = "C:\\LogData"; int retval = 0; retval = cbLogGetFileName(GetFirst, path, filename);</pre>	<pre>string filename = new string('\0', 50); string path = "C:\\LogData"; ErrorInfo status; status = DataLogger.GetFileName(MccService.GetFirst, ref path, ref filename);</pre>

Analog Input Boards

Introduction

All boards that have analog input support the `cbAIn()` / `AIn()` and `cbAInScan()` / `AInScan()` functions, except expansion boards, which only support `cbAIn()`. Boards released after the printing of this manual are described in Readme files contained on the Universal Library disk.

When hardware-paced A/D conversion is not supported, `cbAInScan()` / `AInScan()` loops through software paced conversions. The scan will execute at the maximum speed possible. This speed will vary with CPU speed. The only valid option in this case is `CONVERTDATA`.

Concurrent analog input and output for paced analog inputs, paced analog outputs

For boards with both paced analog inputs and paced analog outputs, concurrent analog input and output scans are supported. That is, these boards allow operations with analog input functions (`cbAInScan/AInScan()` and `cbAPretrig/APretrig`) and analog output functions (`cbAOutScan/AOutScan()`) to overlap without having to call `cbStopBackground()/StopBackground()` between the start of input and output scans.

Trigger support

Digital trigger

If trigger support is "Polled gate" (as opposed to "Hardware"), you implement a trigger by gating the on-board pacer. This disables the on-board pacer. The trigger input is then polled continuously until the trigger occurs. When that happens, the software disables the gate input so that when the trigger returns to its original state, it does not affect the pacer, and acquisition continues until the requested number of samples has been acquired. There are two side effects to this type of trigger:

- The polling portion of the function does not occur in the background, even if the `BACKGROUND` option was specified (although the actual data acquisition does).
- The trigger does not necessarily occur on the rising edge. Acquisition can start at any time after the function is called if the trigger input is at "active" level. For this reason, it is best to use a trigger that goes active for a much shorter time than it is inactive.

Similar to 'Polled gate' triggering is 'Polled digital input' triggering, where the pacer is disabled while the state of a digital input is polled. When the state changes to active, the pacer is enabled by the software. The polled digital input trigger type limitations are very similar to the polled gate type explained above.

Analog trigger

You set up the trigger levels for an analog trigger using the function `cbSetTrigger / SetTrigger`, and passing the appropriate values to the `HighThreshold` and `LowThreshold` arguments.

For most boards that support analog triggering, you can calculate the `HighThreshold` and `LowThreshold` values by passing the required trigger voltage level and the appropriate `Range` to the `cbFromEngUnits / FromEngUnits` function.

However, for some boards, you must manually calculate `HighThreshold` and `LowThreshold`. If a board requires manual calculation, that information will be included in the Trigger information for the specific product in this section. The procedure for manually calculating these values is detailed in the Universal Library Function Reference in the description of the `cbSetTrigger / SetTrigger` function.

Pretrigger implementations

Pretrigger functionality may be implemented through software or hardware. These two methods have different limitations and requirements. Most Measurement Computing products with pretrigger capability are implemented in hardware.

When implemented in hardware, the buffer created using `cbWinBufAlloc()` must be large enough to hold 512 samples more than the requested `TotalCount`. The trigger location is tracked by a counter on the board. When the trigger condition is met, data is acquired and the library functions return the actual number of pretrigger points that were acquired. When run in `BACKGROUND` mode, the `cbGetStatus()` function will typically show `CurCount` rise to the value of `PretrigCount` and remain there while `CurIndex` cycles from 0 to `TotalCount` continuously until the trigger is received.

With the software implementation of pretrigger, the additional space in the buffer is not required. The trigger location is tracked by software. Any triggers that occur before the number of samples defined by the pretrigger count argument are ignored. When run in `BACKGROUND` mode, the `cbGetStatus()` function will typically show `CurCount` at a value of 0 and `CurIndex` at a value of -1 until the trigger is received. They will then rise from of `PretrigCount` to `TotalCount`.

Sampling rate using SINGLEIO

When using this mode of data transfer, the maximum analog sampling rate is dependent on the speed of the computer in which the board is installed. In general, it is in the range of 5 to 50 kHz. If the requested speed cannot be sustained, an overrun error will occur. Data will be returned, but likely there will be gaps. Some boards, such as the **CIO-DAS08**, support this mode only, so the maximum rate attainable with these boards is system-dependent.

PCI-2500 Series

The PCI-2500 Series includes the PCI-2511, PCI-2513, PCI-2515, and PCI -2517 boards.

Analog input

Analog input functions and methods supported

UL:	<code>cbAIn()</code> , <code>cbAInScan()</code> , <code>cbFileAInScan()</code> , <code>cbAPretrig()</code> *, <code>cbATrig()</code> , <code>cbALoadQueue()</code>
UL for .NET:	<code>AIn()</code> , <code>AInScan()</code> , <code>FileAInScan()</code> , <code>APretrig()</code> *, <code>ATrig()</code> , <code>ALoadQueue()</code>
	<p>* Pretrigger capability is implemented in software. <code>PretrigCount</code> must be less than the <code>TotalCount</code> and cannot exceed 100000 samples. <code>TotalCount</code> must be greater than the <code>PretrigCount</code>. If a trigger occurs while the number of collected samples is less than the <code>PretrigCount</code>, that trigger will be ignored. Requires a call to <code>cbSetTrigger (SetTrigger)</code> for the analog trigger type.</p>

Analog input argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, DMAIO, BLOCKIO, EXTTRIGGER
	With EXTTRIGGER mode, the first channel in the scan is the analog trigger channel.
HighChan	<p>PCI-2517, PCI-2515, PCI-2513:</p> <p>0 to 15 in single-ended mode, 0 to 7 in differential mode</p> <p>PCI-2511:</p> <p>0 to 15 in single-ended mode.</p>
Rate	Up to 1 MHz
Range	<p>PCI-2517, PCI-2515, PCI-2513:</p> <p>BIP10VOLTS (± 10 V)</p> <p>BIP5VOLTS (± 5 V)</p> <p>BIP2VOLTS (± 2 V)</p> <p>BIP1VOLTS (± 1 V)</p> <p>BIPPT5VOLTS (± 0.5 V)</p> <p>BIPPT2VOLTS (± 0.2 V)</p> <p>BIPPT1VOLTS (± 0.1 V)</p> <p>PCI-2511:</p> <p>BIP10VOLTS (± 10 V)</p>

Analog output (PCI-2517 and PCI-2515 only)

Analog output functions and methods supported

UL:	<code>cbAOut()</code> , <code>cbAOutScan()</code>
UL for .NET:	<code>AOut()</code> , <code>AOutScan()</code>

Analog output argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, SIMULTANEOUS, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK
	NONSTREAMEDIO can only be used with the number of samples set equal to the size of the FIFO or less. The FIFO holds 524288 samples.
HighChan	<p>PCI-2517: 0 to 3</p> <p>PCI-2515: 0 to 1</p>

Rate	1 MHz
Range	Ignored - Not programmable; fixed at BIP10VOLTS (± 10 volts)
DataValue	0 to 65535 (Refer to " 16-bit values using a signed integer data type " on page 16 for information on 16-bit values using unsigned integers).
Pacing	Hardware pacing, external or internal clock supported.

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigPort()
UL for .NET:	DConfigPort()
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTC
PortType	FIRSTPORTA

Port I/O functions, methods, and argument values supported

UL:	cbDIn(), cbDOut(), cbDInScan(), cbDOutScan()*
UL for .NET:	DIn(), DOut(), DInScan(), DOutScan()*
Options	<p>*FIRSTPORTA and FIRSTPORTB must be set for output to use this function. Refer to <i>DIO PortNum</i> on page 37 for more information.</p> <p>BACKGROUND, CONTINUOUS, EXTCLOCK, EXTTRIGGER, WORDXFER, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK</p>

The EXTTRIGGER option can only be used with the cbDInScan() function. You can use the cbSetTrigger() function to program the trigger for rising edge, falling edge, or the level of the digital trigger input (TTL).

The WORDXFER option can only be used with FIRSTPORTA.

The NONSTREAMEDIO, ADCCLOCKTRIG, and ADCCLOCK options can only be used with the cbDOutScan() function.

The NONSTREAMEDIO option can only be used with the number of samples set equal to the size of the FIFO or less. The FIFO holds 524288 samples.

Rate	12 MHz
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTC
DataValue	<p>0 to 255</p> <p>0 to 65535 using the WORDXFER option with FIRSTPORTA</p>

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn(), cbDBitOut()
UL for .NET:	DBitIn(), DBitOut()
PortType	FIRSTPORTA
BitNum	0 to 23

Counter input

Counter functions and methods supported

UL: `cbCIn()`, `cbCIn32()`, `cbCConfigScan()`, `cbCInScan()`, `cbCClear()`

UL for .NET: `CIn()`, `CIn32()`, `CConfigScan()`, `CInScan()`, `CClear()`

Note: Counters on these boards are zero-based (the first counter number is "0").

Counter argument values

Rate 6 MHz

CounterNum 0 to 3

Options BACKGROUND, CONTINUOUS, EXTTRIGGER

You can use the `cbSetTrigger()` function to program the trigger for rising edge, falling edge, or the level of the digital trigger input (TTL).

LoadValue 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers.)

Timer output

Timer functions and methods supported

UL: `cbTimerOutStart()`, `cbTimerOutStop()`

UL for .NET: `TimerOutStart()`, `TimerOutStop()`

Timer argument values

TimerNum 0 to 1

Frequency 15.260 Hz to 1.0 MHz

Triggering

Trigger functions and methods supported

UL: `cbSetTrigger()`

UL for .NET: `SetTrigger()`

Trigger argument values

TrigType TRIGABOVE, TRIGBELOW, TRIGHIGH, TRIGLOW, TRIGPOSEDGE, TRIGNEGEDGE

Digital triggering (TRIGHIGH, TRIGLOW, TRIGPOSEDGE, TRIGNEGEDGE) is not supported for pre-trigger acquisitions (`cbAPretrig()` function). Analog triggering (TRIGABOVE, TRIGBELOW) is not supported for the `cbDInScan()` function and the `cbCInScan()` function.

Threshold Analog hardware triggering, 12-bit resolution:
0 to 4095 (supported for `cbAInScan()` only)

Analog software triggering, 16-bit resolution:
0 to 65535 (supported for `cbAPretrig()` only)

DAQ input

DAQ input functions and methods supported

UL: `cbDaqInScan()`

UL for .NET: `DaqInScan()`

DAQ input argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, DMAIO, BLOCKIO, EXTTRIGGER
ChanTypeArray	ANALOG, DIGITAL8, DIGITAL16, CTR16, CTR32LOW, CTR32HIGH, SETPOINTSTATUS
ChanArray	<p>ANALOG: PCI-2517, PCI-2515, PCI-2513: 0 to 15 in single-ended mode, 0 to 7 in differential mode</p> <p> PCI-2511: 0 to 15 in single-ended mode</p> <p>DIGITAL8: FIRSTPORTA, FIRSTPORTB, FIRSTPORTC</p> <p>DIGITAL16: FIRSTPORTA</p> <p>CTR16: 0-3 counters</p> <p>CTR32LOW: 0-3 counters</p> <p>CTR32HIGH: 0-3 counters</p> <p>SETPOINTSTATUS: 16-bit port that indicates the current state of the 16 possible setpoints.</p> <p>ChanTypeArray flag value:</p> <p>SETPOINT_ENABLE: Enables a setpoint. Refer to <i>Hardware Considerations</i> on page 36 for more information.</p>
Rate	<p>Analog: Up to 1 MHz</p> <p>Digital: Up to 12 MHz if no analog channel is selected. Otherwise up to 1 MHz.</p> <p>Counter: Up to 12 MHz if no analog channel is selected. Otherwise up to 1 MHz.</p>
GainArray	<p>ANALOG only; ignore for other ChanTypeArray values.</p> <p>PCI-2517, PCI-2515, PCI-2513:</p> <p>BIP10VOLTS (± 10 V)</p> <p>BIP5VOLTS (± 5 V)</p> <p>BIP2VOLTS (± 2 V)</p> <p>BIP1VOLTS (± 1 V)</p> <p>BIPPT5VOLTS (± 0.5 V)</p> <p>BIPPT2VOLTS (± 0.2 V)</p> <p>BIPPT1VOLTS (± 0.1 V)</p> <p>PCI-2511:</p> <p>Ignored – fixed at BIP10VOLTS (± 10 V)</p>
ChanCount	Number of elements in ChanArray, ChanTypeArray and GainArray. Up to 512 elements max.
PretrigCount	100000 max. This argument is ignored if the EXTTRIGGER option is not specified.

DAQ triggering

DAQ trigger functions and methods supported

UL: `cbDaqSetTrigger()`

UL for .NET: `DaqSetTrigger()`

DAQ trigger argument values

TrigSource TRIG_IMMEDIATE, TRIG_EXTTTL, TRIG_ANALOGHW, TRIG_ANALOGSW,
TRIG_DIGPATTERN, TRIG_COUNTER, TRIG_SCANCOUNT

TrigSense RISING_EDGE, FALLING_EDGE, ABOVE_LEVEL, BELOW_LEVEL, EQ_LEVEL, NE_LEVEL

TrigEvent START_EVENT, STOP_EVENT

DAQ setpoint

DAQ setpoint functions and methods supported

UL: `cbDaqSetSetpoints()`

UL for .NET: `DaqSetSetpoints()`

DAQ setpoint argument values

SetpointFlagsArray SF_EQUAL_LIMITA, SF_LESSTHAN_LIMITA, SF_GREATERTHAN_LIMITB,
SF_OUTSIDE_LIMITS, SF_HYSTERESIS, SF_UPDATEON_TRUEONLY,
SF_UPDATEON_TRUEANDFALSE

SetpointOutputArray SO_NONE, SO_FIRSTPORTC, SO_TMR0, SO_TMR1

also available for PCI-2515 and PCI-2517:

SO_DAC0, SO_DAC1

also available for PCI-2517:

SO_DAC2, SO_DAC3

LimitAArray Any value valid for the associated input channel
Ignored for SF_GREATERTHAN_LIMITB

LimitBArray Any value valid for the associated input channel and less than LimitA
Ignored for SF_EQUAL_LIMITA, SF_LESSTHAN_LIMITA

Output#Array For SetpointOutputArray = SO_NONE:
Ignored

For SetpointOutputArray = SO_FIRSTPORTC:
0 to 65535

For SetpointOutputArray = SO_TMR#:
0 (to disable timer) or 15.26 to 1000000 (to set output frequency)

For SetpointOutputArray = SO_DAC#:
Voltage values between -10 and +10

OutputMask#Array For SetpointOutputArray = SO_FIRSTPORTC:
0 to 65535

For SetpointOutputArray = all other values:
Ignored

SetpointCount 0 (to disable setpoints) to 16

DAQ output (PCI-2517 and PCI-2515 only)

DAQ output functions and methods supported

UL:	<code>cbDaqOutScan()</code>
UL for .NET:	<code>DaqOutScan()</code>

DAQ output argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, SIMULTANEOUS, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK	
ChanType	ANALOG, DIGITAL16	
ChanArray	ANALOG:	PCI-2517: 0 to 3 PCI-2515: 0 to 1
	DIGITAL16:	FIRSTPORTA (FIRSTPORTB must be configured as an output)
Rate	ANALOG:	Up to 1 MHz
	DIGITAL16:	Up to 12 MHz if no analog channel is selected. Otherwise up to 1 MHz.
Range	Ignored	

Hardware considerations

Channel count

For input and output scans, the count must be set to an integer multiple of the number of channels or a BADCOUNT error is returned.

Sampling and update rates

Sampling and update rates are system-dependent. Data overruns/underruns may occur with higher sampling rates when using BACKGROUND and CONTINUOUS modes. To avoid this, use a larger buffer/count size, or use NONSTREAMEDIO mode, if supported. The minimum size buffer is 256 for `cbAOutScan()`. Values less than that result in a BADBUFFERSIZE error.

Settling time

For most applications, settling time should be left at the default value of 1 μ s. However, if you are scanning multiple channels and one or more channels are connected to a high impedance source, you may get better results by increasing the settling time. Keep in mind that increasing the settling time reduces the maximum acquisition rate. You can set the time between A/D conversions with the ADC Settling Time option in *InstaCal*. Select between 1 μ s, 5 μ s, 10 μ s, or 1 ms.

Setpoints

You enable setpoints with the SETPOINT_ENABLE flag. This flag must be OR'ed with the ChanTypeArray argument values. You set the setpoint criteria with the `cbDaqSetSetpoints()/DaqSetSetpoints()`. The number of channels set with the SETPOINT_ENABLE flag must match the number of setpoints set by the SetpointCount argument (`cbDaqSetSetpoints()/DaqSetSetpoints()`).

Output non-streamed data to a DAC output channel

With NONSTREAMEDIO mode, you can output non-streamed data to a specific DAC output channel. The aggregate size of the data output buffer must be less than or equal to the size of the internal data output FIFO in the device. The FIFO holds 524288 samples. This allows the data output buffer to be loaded into the device's internal output FIFO. Once the sample data are transferred or downloaded to the device, the device is responsible for outputting the data. You can't make any changes to the output buffer once the output begins.

Trigger DAC output operations with the ADC clock

Specify the `ADCCLOCKTRIG` option to trigger a data output operation upon the start of the ADC clock.

DIO PortNum

For `cbDOutScan()/DOutScan()` and `cbDaqOutScan()/DaqOutScan()`, `FIRSTPORTA` and `FIRSTPORTB` are treated as one 16-bit port. These functions can only be used with `FIRSTPORTA`. You must configure both `FIRSTPORTA` and `FIRSTPORTB` for output using the `cbDConfigPort()` function.

Synchronous scanning with multiple boards

You can operate up to four PCI-2500 Series boards synchronously by setting the direction of the A/D and D/A pacer pins (**XAPCR** or **XDPCR**) in *InstaCal*.

On the board used to pace each device, set the pacer pin that you want to use (XAPCR or XDPCR) for *Output*. On the board(s) that you want to synchronize with this board, set the pacer pin that you want to use (XAPCR or XDPCR) for *Input*.

You set the direction using the *InstaCal* configuration dialog's **XAPCR Pin Direction** and **XDPCR Pin Direction** settings. If you have an older version of *InstaCal*, these settings might be labeled "ADC Clock Output" (set to *Enabled* to configure XAPCR for output) or "DAC Clock Output" (set to *Enabled* to configure XDPCR for output).

Wire the pacer pin configured for output to each of the pacer input pins that you want to synchronize.

PCI-DAS6000 Series

Analog input

Analog input functions and methods supported

UL:	<code>cbAIn()</code> , <code>cbAInScan()</code> , <code>cbATrig()</code> , <code>cbAPretrig()</code> , <code>cbFileAInScan()</code> , <code>cbFilePretrig()</code> , <code>cbALoadQueue()</code>
UL for .NET:	<code>AIn()</code> , <code>AInScan()</code> , <code>ATrig()</code> , <code>APretrig()</code> , <code>FileAInScan()</code> , <code>FilePretrig()</code> , <code>ALoadQueue()</code>

Analog input argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, DMAIO, BLOCKIO, BURSTMODE, EXTTTRIGGER
---------	--

Packet size is 512 for all PCI-6000 Series in most configurations. The exceptions are shown below.

Device	Aggregate rate	Packet size
PCI-DAS6040	400 kHz – 800 kHz	1024
PCI-DAS6070	Greater than 800 kHz	2048
PCI-DAS6071		

HighChan	0 to 15 in single-ended mode, 0 to 7 in differential mode
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For **PCI-DAS6031**, **PCI-DAS6033**, and **PCI-DAS6071**, the following additional argument values are also valid:

16 to 63 in single-ended mode, 8 to 31 in differential mode

Rate	PCI-DAS6030 , PCI-DAS6031 , PCI-DAS6032 , and PCI-DAS6033
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Up to 100000

PCI-DAS6013, **PCI-DAS6014**, **PCI-DAS6023**, **PCI-DAS6025**, **PCI-DAS6034**,
PCI-DAS6035, and **PCI-DAS6036**

Up to 200000

PCI-DAS6040

Up to 500000 Single-channel

Up to 250000 Multi-channel

PCI-DAS6052

Up to 333000

PCI-DAS6070, **PCI-DAS6071**

Up to 1250000

Range	PCI-DAS6013* , PCI-DAS6014* , PCI-DAS6023 , PCI-DAS6025 , PCI-DAS6034* , PCI-DAS6035* , and PCI-DAS6036*
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BIP10VOLTS (± 10 V)

BIP5VOLTS (± 5 V)

BIPPt5VOLTS (± 0.5 V)

BIPPt05VOLTS (± 0.05 V)

*** Note:** Mixing high gains (BipPt05Volts, BipPt5Volts) with low gains (Bip5Volts, Bip10Volts) within an `AInScan()` function is not supported.

PCI-DAS6030, PCI-DAS6031, PCI-DAS6032 and PCI-DAS6033

BIP10VOLTS	(± 10 V)	UNI10VOLTS	(0 to 10 V)
BIP5VOLTS	(± 5 V)	UNI5VOLTS	(0 to 5 V)
BIP2VOLTS	(± 2 V)	UNI2VOLTS	(0 to 2 V)
BIP1VOLTS	(± 1 V)	UNI1VOLTS	(0 to 1 V)
BIPPT5VOLTS	(± 0.5 V)	UNIPT5VOLTS	(0 to 0.5 V)
BIPPT2VOLTS	(± 0.2 V)	UNIPT2VOLTS	(0 to 0.2 V)
BIPPT1VOLT	(± 0.1 V)	UNIPT1VOLTS	(0 to 0.1 V)

PCI-DAS6040, PCI-DAS6052, PCI-DAS6070 and PCI-DAS6071

BIP10VOLTS	(± 10 V)	UNI10VOLTS	(0 to 10 V)
BIP5VOLTS	(± 5 V)	UNI5VOLTS	(0 to 5 V)
BIP2PT5VOLTS	(± 2.5 V)	UNI2VOLTS	(0 to 2 V)
BIP1VOLTS	(± 1 V)	UNI1VOLTS	(0 to 1 V)
BIPPT5VOLTS	(± 0.5 V)	UNIPT5VOLTS	(0 to 0.5 V)
BIPPT25VOLTS	(± 0.25 V)	UNIPT2VOLTS	(0 to 0.2 V)
BIPPT1VOLTS	(± 0.1 V)	UNIPT1VOLTS	(0 to 0.1 V)
BIPPT05VOLTS	(± 0.05 V)		

Analog output

PCI-DAS6014, PCI-DAS6025, PCI-DAS6030, PCI-DAS6031, PCI-DAS6035, PCI-DAS6036, PCI-DAS6040, PCI-DAS6052, PCI-DAS6070 and PCI-DAS6071

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options `SIMULTANEOUS`, `BACKGROUND`, `EXTCLOCK`, `CONTINUOUS` (packet size = 512)

HighChan 0 to 1

Rate **PCI-DAS6014, PCI-DAS6025, PCI-DAS6035, PCI-DAS6036**

10 kHz

PCI-DAS6030 and PCI-DAS6031

100 kHz

PCI-DAS6040

1 MHz single-channel

500 kHz multi-channel

PCI-DAS6052

333 kHz

PCI-DAS6070 and PCI-DAS6071

1.0 MHz

Range **PCI-DAS6014, PCI-DAS6025, PCI-DAS6035 and PCI-DAS6036**

Ignored - Not programmable; fixed at BIP10VOLTS (± 10 V)

PCI-DAS6030, PCI-DAS6031, PCI-DAS6040, PCI-DAS6052, PCI-DAS6070 and PCI-DAS6071

	BIP10VOLTS	(± 10 V)	UNI10VOLTS	(0 to 10 V)
DataValue	0 to 4095			

For the **PCI-DAS6014, PCI-DAS6030, PCI-DAS6031, PCI-DAS6036 and PCI-DAS6052**, the following additional argument value is also valid:

0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers).

Pacing	Hardware pacing, external or internal clock supported.
--------	--

Digital I/O**Digital I/O functions and methods supported**

UL:	cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigBit(), cbDConfigPort()
UL for .NET:	DOut(), DIn(), DBitIn(), DBitOut(), DConfigBit(), DConfigPort(), GetDInMask(), GetDOutMask()

Digital I/O argument values

PortNum	AUXPORT*
DataValue	0 to 255
BitNum	0 to 7

For the **PCI-DAS6025**, the following additional argument values are also valid

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for FIRSTPORTCL or FIRSTPORTCH; 0 to 255 for FIRSTPORTA or FIRSTPORTB
BitNum	0 to 23 for FIRSTFIRSTPORTA

*AUXPORT is bitwise configurable for these boards, and must be configured using cbDConfigBit()/DConfigBit() or cbDConfigPort()/DConfigPort() before use.

Counter I/O**Counter functions and methods supported**

UL:	cbC8254Config(), cbCIn(), cbCLoad()
UL for .NET:	C8254Config(), CIn(), CLoad()

Counter argument values

CounterNum	1 to 2
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (Refer to " 16-bit values using a signed integer data type " on page 16 for information on 16-bit values using unsigned integers.)
RegNum:	LOADREG1, LOADREG2

Triggering

Trigger functions and methods supported

UL:	<code>cbSetTrigger()</code>
UL for .NET:	<code>SetTrigger()</code>

Trigger argument values

TrigType	TRIGPOSEDGE, TRIGNEGEDGE, GATEHIGH, GATELOW
----------	---

For the **PCI-DAS6030, PCI-DAS6031, PCI-DAS6032, PCI-DAS6033, PCI-DAS6040, PCI-DAS6052, PCI-DAS6070** and **PCI-DAS6071**, the following additional argument values are valid:

TRIGABOVE, TRIGBELOW, GATENEGHYS, GATEPOSHYS, GATEABOVE, GATEBELOW, GATEINWINDOW, GATEOUTWINDOW

Threshold	PCI-DAS6040, PCI-DAS6070 and PCI-DAS6071 0 to 255
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PCI-DAS6030, PCI-DAS6031, PCI-DAS6032, PCI-DAS6033, and PCI-DAS6052
0 to 4095

Event notification

Event notification functions and methods supported

UL:	<code>cbEnableEvent()</code> , <code>cbDisableEvent()</code>
UL for .NET:	<code>EnableEvent()</code> , <code>DisableEvent()</code>

Event notification argument values

EventType	ON_SCAN_ERROR, ON_PRETRIGGER*, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN, ON_END_OF_AO_SCAN**
-----------	--

*Note that the `EventData` for `ON_PRETRIGGER` events may not be accurate. In general, this value will be below the actual number of pretrigger samples available in the buffer.

Not supported for **PCI-DAS6013, PCI-DAS6023, PCI-DAS6032, PCI-DAS6033, and PCI-DAS6034.

Hardware considerations

Advanced timing and control configuration

You can access the advanced features provided by the Auxiliary Input/Output and DAQ-Sync interfaces through the board configuration page of *InstaCal* and the UL functions `cbGetSignal()` and `cbSelectSignal()`, or the UL for .NET methods `GetSignal()` and `SelectSignal()` *.

`ADC_TB_SRC` and `DAC_TB_SRC` are intended to synchronize the timebase of the analog input and output pacers across two or more boards. Internal calculations of sampling and update rates assume that the external timebase has the same frequency as its internal clock. Adjust sample rates to compensate for differences in clock frequencies.

For example, if the external timebase has a frequency of 10 MHz on a board that has an internal clock frequency of 40 MHz, the scan function samples or updates at a rate of about 1/4 the rate entered. However, while compensating for differences in the external timebase and internal clock frequency, if the rate entered results in an invalid pacer count, the function returns a `BADRATE` error.

*Although the **PCI-DAS6013** and **PCI-DAS6014** both support `cbSelectSignal/SelectSignal()`, these boards do not support DAQ-Sync. Therefore:

- Using the `DS_CONNECT` option with the `Connection` argument for the `cbSelectSignal()` function generates a `BADCONNECTION` error.
- Using the `DsConnector` option with the `connectionPin` parameter for the `SelectSignal()` method generates a `BADCONNECTION` error.

Pacing analog input

Hardware pacing, external or internal clock supported. The clock edge is selectable through *InstaCal* and `cbSelectSignal / SelectSignal()`.

When using `EXTCLOCK` and `BURSTMODE` together, do not use the A/D External Pacer to supply the clock. Use the A/D Start Trigger input instead. Since `BURSTMODE` is actually paced by the internal burst clock, specifying `EXTCLOCK` when using `BURSTMODE` is equivalent to specifying `EXTTRIGGER`.

Except for `SINGLEIO` transfers, `CONTINUOUS` mode scans require enough memory for two packets, or 1024 samples. The packet size is 512 samples.

Analog input configuration

16 channel boards: The analog input mode may be 8 channel differential, 16 channel single-ended referenced to ground or 16 channel single-ended non-referenced, and may be selected using *InstaCal*.

64-channel boards: The analog input mode may be 32 channel differential, 64 channel single-ended referenced to ground, or 64 channel single-ended non-referenced, and may be selected using *InstaCal*.

Triggering and gating

Digital (TTL) hardware triggering is supported for the entire series. `cbSetTrigger() / SetTrigger()` is supported for `GATEHIGH`, `GATELOW`, `TRIGPOSEDGE`, `TRIGNEGEDGE`.

The A/D PACER GATE input is used for gating with `GATEHIGH` or `GATELOW`. The A/D START TRIGGER input is used for triggering with `TRIGPOSEDGE` and `TRIGNEGEDGE`.

When using `cbAPretrig()` or `cbFilePretrig() / APretrig() or FilePretrig()`, use the A/D Stop Trigger input to supply the trigger.

For the **PCI-DAS6030, PCI-DAS6031, PCI-DAS6032, PCI-DAS6033, PCI-DAS6040, PCI-DAS6052, PCI-DAS6070 and PCI-DAS6071**: Analog hardware triggering and gating are supported.

`cbSetTrigger()/SetTrigger()` is supported for `TRIGABOVE`, `TRIGBELOW`, `GATENEHYS`, `GATEPOSHYS`, `GATEABOVE`, `GATEBELOW`, `GATEINWINDOW`, `GATEOUTWINDOW`.

The analog trigger source may be set via *InstaCal* as either the ATRIG input (pin #43 on the I/O connector), or as the first channel in the scan (CH# IN). To use the ATRIG input as the trigger source, set the *InstaCal* "Analog Input Trig Source" to "Analog Trigger Pin." To use the first scanned channel as the trigger source, set *InstaCal* to "1st Chan in the Scan."

Recommended trigger source when using analog gating features

If using analog gating features, we strongly recommend setting the ATRIG input as the trigger source.

Using the ATRIG input as the Trigger Input

When the trigger source is set to "Analog Trigger Pin," analog thresholds are set relative to the ± 10 V range.

Using the "First Channel in Scan" as the Trigger Input

When the trigger source is set to "1st Chan in Scan," the range used for the thresholds is the same as the A/D channel. When using analog gating features with "1st Channel in Scan" as the trigger source, be careful to only scan a single channel.

Calculating Analog Trigger Thresholds

Analog thresholds for the **PCI-DAS6030**, **PCI-DAS6031**, **PCI-DAS6032**, **PCI-DAS6033** and **PCI-DAS6052** are 12-bit values. For example: a threshold value of 0 equates to -10 volts (V), while a threshold value of 4095 equates to +9.9976 volts (V). Analog thresholds for the **PCI-DAS6040**, **PCI-DAS6070** and **PCI-DAS6071** are 8-bit values. For example: a threshold value of 0 equates to -10 V, while a threshold value of 255 equates to +9.92188 V.

You need to manually calculate trigger threshold values for these PCI-DAS6000 Series boards. For information on calculating thresholds, refer to the "Notes" section in the "cbSetTrigger()" and "SetTrigger()" in the *Universal Library Function Reference*.

Channel-Gain queue

When using `cbALoadQueue()` / `ALoadQueue()`, up to 8k elements may be loaded into the queue. For Models **PCI-DAS6013**, **PCI-DAS6014**, **PCI-DAS6034**, **PCI-DAS6035**, and **PCI-DAS6036**: Mixing high gains (`BipPt05Volts`, `BipPt5Volts`) with low gains (`Bip5Volts`, `Bip10Volts`) within an `AInScan()` function is not supported.

Analog Output

Using `cbAOutScan()` / `AOutScan()` in `CONTINUOUS` mode requires a minimum sample size of two packets. A packet is 512 samples.

Digital I/O configuration

`AUXPORT` is bitwise configurable for these boards, and must be configured using `cbDConfigBit()` or `cbDConfigPort()` / `DConfigBit()` or `DConfigPort()` before use.

Counters

The source for counters 1 and 2 may be internal 10 MHz, internal 100 kHz, or external, and is selectable using *InstaCal*.

PCI-DAS4020 Series

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbAPretrig()`, `cbFileAInScan()`,
 `cbFilePretrig()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `APretrig()`, `FileAInScan()`, `FilePretrig()`

Analog input argument values

Options BACKGROUND, BLOCKIO*, CONTINUOUS, CONVERTDATA, DMAIO, EXTCLOCK,
 EXTTRIGGER, and SINGLEIO

* PCI-4020 Series packet size based on Options settings is as follows:

Options setting	Packet size
BLOCKIO	2048 See details on chain and packet size in "Memory configuration" on page 46.

HighChan 3 max. When scanning multiple channels, the number of channels scanned must be even.

Rate Up to 20000000. Contiguous memory may be required to achieve maximum performance. Refer to "[Memory configuration](#)" on page 46 for details.

Range BIP5VOLTS (± 5 V)
 BIP1VOLTS (± 1 V)

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options NONE

HighChan 1 max

Count 2

Rate Ignored

Range BIP10VOLTS (± 10 V)
 BIP5VOLTS (± 5 V)

DataValue 0 to 4095

Pacing Software only

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`, `cbDConfigPort()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`

Digital I/O argument values

PortNum FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH

DataValue	0 to 255 for FIRSTPORTA or FIRSTPORTB; 0 to 15 for FIRSTPORTCL or FIRSTPORTCH
BitNum	0 to 23 for FIRSTPORTA

Counter I/O

Counter functions and methods supported

None

Triggering

Trigger functions and methods supported

UL: `cbSetTrigger()`

UL for .NET: `SetTrigger()`

Trigger argument values

TrigType	TRIGPOSEDGE, TRIGNEGEDGE, TRIGABOVE, TRIGBELOW, GATEHIGH, GATELOW, GATENEGHYS, GATEPOSHYS, GATEABOVE, GATEBELOW, GATEINWINDOW, GATEOUTWINDOW
Threshold	0 to 4095

Event notification

Event notification functions and methods supported

UL: `cbEnableEvent()`, `cbDisableEvent()`

UL for .NET: `EnableEvent()`, `DisableEvent()`

Event notification argument values

EventType	ON_SCAN_ERROR, ON_PRETRIGGER [†] , ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN
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Hardware considerations

Pacing analog input

Hardware pacing, external or internal clock supported. The clock source can be set via *InstaCal* to either the "Trig/Ext Clk" BNC input or the "A/D External Clock" input on the 40 pin connector (P3). Configuring for the BNC clock input will disable the clock input (pin 10) on the 40-pin connector. When the EXTCLOCK option is used, the clock signal presented to the "Trig/Ext Clk" BNC input or the "A/D External Clock" input is divided by 2 in one or two channel mode and is divided by 4 in four channel mode. If both EXTCLOCK and EXTTRIGGER are used, both the Trigger BNC and pin 10 on the 40-pin connector require signals. This is further explained in the "Triggering and gating" section below. When using EXTCLOCK, the Rate argument is used by the Universal Library to calculate the appropriate chain size. Set the Rate argument to the approximate rate used by the external clock to pace acquisitions.

When executing `cbAInScan()/AInScan()` with the EXTCLOCK option, the first three clock pulses are used to set up the PCI-DAS4020/12, and the first sample is actually taken on the fourth clock pulse.

The packet size varies. See "[Memory configuration](#)" on page 46 for more information.

Triggering and gating

Digital (TTL) hardware triggering supported. The trigger source can be set via *InstaCal* to either the "Trig/Ext Clk" BNC input, the "A/D Start Trigger" input on the 40-pin connector (P3) or the "A/D Stop

[†] The EventData for ON_PRETRIGGER events may not be accurate. In general, this value is below the actual number of pretrigger samples available in the buffer.

Trigger" input on the 40-pin connector (P3). Use the A/D Start Trigger input for the `cbAInScan()` and `cbFileAInScan()` functions, and `AInScan()` and `FileAInScan()` methods. For the `cbAPretrig()` or `cbFilePretrig()` functions, and the `APretrig()` or `FilePretrig()` method, use the A/D Stop Trigger input.

When using both `EXTCLOCK` and `EXTTRIGGER` options, one of the signals (either clock or trigger) must be assigned to the Trig/Ext Clk BNC input. The function of the Trigger BNC is determined by the setting of "Trig/Ext Clock Mode" in *InstaCal*. The Trig/Ext Clock BNC can be set to function as either the trigger ("A/D Start Trigger") or the clock ("A/D External Clock"). Pin 10 on the 40-pin connector then assumes the opposite function.

Analog hardware triggering supported. The trigger source can be set via *InstaCal* to any of the analog BNC inputs. `cbSetTrigger()/SetTrigger()` is supported for `TRIGBELOW` and `TRIGABOVE` trigger types. Analog thresholds are set relative to the voltage range set in the scan. For example, using a range of `BIP1VOLTS` during a `cbAInScan()/AInScan()`, (0) corresponds to -1 volt (V) and 4095 corresponds to +1 V.

When using the `cbAPretrig()` function or the `APretrig()` method, use either the TRIGGER BNC or pin 8 of the 40 pin connector. To use the BNC, set *InstaCal* "Trig/Ext Clock Mode" to A/D Stop Trigger; otherwise, if not set to this selection, pin 8 of the 40-pin connector is used.

When using `cbAPretrig()/APretrig()` with `EXTCLOCK`, the two inputs are required. The TRIGGER BNC can be set to function as either the pacer clock or the trigger. For the BNC to be setup as the pacer clock, set *InstaCal* "Trig/Ext Clk Mode" to A/D External Clock. To use the BNC as the trigger, set this *InstaCal* option to A/D Stop Trigger. If neither of these selections are used, the 40-pin connector will be used for both inputs; pin 8 will be input for A/D Stop Trigger, and pin 10 will be input for the pacer clock signal.

Digital (TTL) hardware gating supported. The gate source can be set via *InstaCal* to either the "Trig/Ext Clk" BNC input or the "A/D Pacer Gate" input on the 40-pin connector (P3).

Analog hardware gating supported. Analog thresholds are set relative to the voltage range set in the scan. For example, using a range of `BIP1VOLTS` during a `cbAInScan()/AInScan()`, (0) corresponds to (-1V) and 4095 corresponds to +1V.

The gate must be in the active (enabled) state before starting an acquisition.

For `EXTCLOCK` or `EXTTRIGGER` (digital triggering) using the BNC connector, *InstaCal* provides a configuration setting for thresholds. The selections available are either 0 V or 2.5 V. Use 0 V if the incoming signal is `BIPOlar`. Use the 2.5 V option if the signal is `UNIPOlar`, for example, standard TTL.

When using both `EXTCLOCK` and `EXTTRIGGER` options, one of the signals (either clock or trigger) must be assigned to the Trig/Ext Clk BNC input.

Memory configuration

In order to achieve the maximum sample rate under some conditions, a contiguous area of memory must be set up. The following is a guide that can be used to determine whether or not you need to set up this memory, and how to accomplish it using *InstaCal*.

If the number of samples you are acquiring is less than 2k samples (2,048), then you do NOT need to set up contiguous memory (leave the **Memory Size** edit box in *InstaCal* at zero).

If you are acquiring more than 2,048 samples, contiguous memory may be required, depending on sample rate. Use the table below to determine if contiguous memory is required.

# of Channels	Rate requiring contiguous memory (when sample count > 2048)
1	> 4 MHz
2	>2 MHz
4	>1 MHz

If contiguous memory is required, follow the *InstaCal* procedures below to set the size of the contiguous memory to reserve:

1. Run *InstaCal*, select the **PCI-DAS4020** board and click the **Configure** tab.
2. In the **Memory Size** edit box for the **Contiguous Memory Settings**, enter the amount of memory in kilobytes that you need for the acquisition.

To calculate the number of kilobytes required, use the following formula:

$$(\text{\# of kilobytes (KB)}) = \{(\text{\# of samples}) \times (2 \text{ bytes/sample}) \times (1 \text{ KB}/1024 \text{ bytes})\}$$

or

$$(\text{\# of KB}) = \{(\text{\# of samples})/512\}$$

Memory is allocated in blocks of 4 KB. As a consequence, *InstaCal* adjusts the amount entered upward to the nearest integer multiple of 4 KB. For example, the contiguous memory requirements for a 10,000-sample acquisition would be:

$$(10,000/512) = 19.5 \text{ rounded up to multiple of 4 KB} = 20 \text{ KB.}$$

The maximum number of samples allowed for the given contiguous memory size is displayed as the **Sample Count** (displayed below the **Memory Size** edit box).

Note: You can set the size of the contiguous memory up to 262144k, or 134,217,728 samples.

3. Reboot the computer. The Universal Library attempts to reserve the desired amount of contiguous memory at boot up time. If it is unable to reserve all the memory requested, the amount successfully reserved memory displays in the **Memory Size** entry when you run *InstaCal*.
4. Run *InstaCal*. In the **Memory Size** entry, verify the size of the contiguous memory that was successfully reserved.

Repeat this procedure to change or free the contiguous memory.

The size of the block shown in *InstaCal* is the *total contiguous memory* that is available to *all boards installed*. Other installed boards that call the `cbWinBufAlloc()` function or `WinBufAlloc()` method will also use this contiguous memory, so plan the size of the contiguous memory buffer accordingly.

With the following functions and methods, be aware of packet size, and adjust the number of samples acquired accordingly:

- `cbAPretrig()/APretrig()`
- `cbAInScan()/AInScan()` with the **CONTINUOUS** scan option.

These functions and methods use a circular buffer. Align the data by packets in the buffer. For these functions, the total number of samples must be greater than one packet (refer to the following table), and must be an integer multiple of packet size. In addition, contiguous memory must be used if noted in the following table. The minimum value for contiguous memory is calculated using the formula from step 2 above:

$$(\text{\# of KB}) = \{(\text{\# of samples}) / 512\}$$

For example, to run `cbAInScan` on one channel at 18 MHz with the `CONTINUOUS` option set, determine the minimum sample size from the table to be 262,144 (since the `Rate` is between 14 and 20 MHz). The minimum contiguous memory is calculated as:

$$(262,144 / 512) = 512 \text{ KB}$$

Number of Channels	Rate in MHz	Packet Size in Samples	Minimum Sample Size (two packets)	Contiguous Memory	Min Contiguous Memory (based on Min Sample Size)
1	$20 \geq \text{Rate} \geq 13.3$	131,072	262,144	Required	512 KB
	$13.3 > \text{Rate} > 4$	65,536	131,072	Required	256 KB
	$4 \geq \text{Rate} \geq 2$	4,096	8,192	Not Required	0 KB
	$2 > \text{Rate}$	2,048	4,096	Not Required	0 KB
2	$20 \geq \text{Rate} \geq 6.6$	131,072	262,144	Required	512 KB
	$6.6 > \text{Rate} \geq 2$	65,536	131,072	Required	256 KB
	$2 > \text{Rate} \geq 1$	4,096	8,192	Not Required	0 KB
	$1 > \text{Rate}$	2,048	4,096	Not Required	0 KB
4	$10 \geq \text{Rate} \geq 3.3$	131,072	262,144	Required	512 KB
	$3.3 > \text{Rate} \geq 1$	65,536	131,072	Required	256 KB
	$1 > \text{Rate} \geq 0.5$	4,096	8,192	Not Required	0 KB
	$0.5 > \text{Rate}$	2,048	4,096	Not Required	0 KB

*Note that the `EventData` for `ON_PRETRIGGER` events may not be accurate. In general, this value will be below the actual number of pretrigger samples available in the buffer.

PCI-DAS64/Mx/16 Series

Analog input

Analog input functions and methods supported

UL:	cbAIn(), cbAInScan(), cbATrig(), cbAPretrig(), cbFileAInScan(), cbFilePretrig(), cbALoadQueue()
UL for .NET:	AIn(), AInScan(), ATrig(), APretrig(), FileAInScan(), FilePretrig(), ALoadQueue()

Analog input argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, DMAIO, BLOCKIO, BURSTMODE, EXTTTRIGGER			
HighChan	0 to 63 in single-ended mode, 0 to 31 in differential mode			
Rate	PCI-DAS64/M3/16 Single-channel, Single-range: Up to 3000000 Multi-channel, Single-range: Up to 1500000 Channel/Gain Queue: Up to 750000 PCI-DAS64/M2/16 Single-channel, Single-range: Up to 2000000 Multi-channel, Single-range: Up to 1500000 Channel/Gain Queue: Up to 750000 PCI-DAS64/M1/16 Single-channel, Single-range: Up to 1000000 Multi-channel, Single-range: Up to 1000000 Channel/Gain Queue: Up to 750000			
Range	BIP5VOLTS	(±5 V)	UNI5VOLTS	(0-5 V)
	BIP2PT5VOLTS	(±2.5 V)	UNI2PT5VOLTS	(0-2.5 V)
	BIP1PT25VOLTS	(±1.25 V)	UNI1PT25VOLTS	(0-1.25 V)
	BIPPT625VOLTS	(±.625 V)		

Analog output

Analog output functions and methods supported

UL:	cbAOut(), cbAOutScan()
UL for .NET:	AOut(), AOutScan()

Analog output argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, SIMULTANEOUS
HighChan	1 max
Rate	Up to 100000
Range	Ignored - Not programmable; fixed at BIP5VOLTS (±5 V)
DataValue	0 to 65535 (Refer to " 16-bit values using a signed integer data type " on page 16 for information on 16-bit values using unsigned integers.)

Digital I/O

Digital I/O functions and methods supported

UL:	cbDOut (), cbDIn (), cbDBitIn (), cbDBitOut (), cbDConfigPort ()
UL for .NET:	DOut (), DIn (), DBitIn (), DBitOut (), DConfigPort ()

Digital I/O argument values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH, AUXPORT
DataValue	0 to 15 for FIRSTPORTCL or FIRSTPORTCH or AUXPORT 0 to 255 for FIRSTPORTA or FIRSTPORTB
BitNum	0 to 23 for FIRSTPORTA 0 to 3 for AUXPORT

Counter I/O

Counter functions and methods supported

UL:	cbC8254Config (), cbCIn (), cbCLoad ()
UL for .NET:	C8254Config (), CIn (), CLoad ()

Counter argument values

CounterNum	1
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (Refer to " 16-bit values using a signed integer data type " on page 16 for information on 16-bit values using unsigned integers.)
RegNum:	LOADREG1

Triggering

Trigger functions and methods supported

UL:	cbSetTrigger ()
UL for .NET:	SetTrigger ()

Trigger argument values

TrigType	TRIGPOSEDGE, TRIGNEGEDGE, TRIGABOVE, TRIGBELOW, GATEHIGH, GATELOW, GATENEGHYS, GATEPOSHYS, GATEABOVE, GATEBELOW, GATEINWINDOW, GATEOUTWINDOW
Threshold	0 to 65535 (Refer to " 16-bit values using a signed integer data type " on page 16 for information on 16-bit values using unsigned integers.)

Event notification

Event notification functions and methods supported

UL:	cbEnableEvent (), cbDisableEvent ()
UL for .NET:	EnableEvent (), DisableEvent ()

Event notification argument values

EventType	ON_SCAN_ERROR, ON_PRETRIGGER, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN, ON_END_OF_AO_SCAN
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Hardware considerations

Pacing analog input

- Hardware pacing, external or internal clock supported.
- The clock edge used to trigger acquisition for the external pacer may be rising or falling and is selectable using *InstaCal*.
- The packet size is 512 samples.

Analog Input configuration

The analog input mode may be 32 channel differential or 64 channel single-ended and may be selected using *InstaCal*.

Analog Input options

Except for `SINGLEIO` transfers, `CONTINUOUS` mode scans require enough memory for half FIFO of memory.

Triggering and gating

Digital (TTL) hardware triggering supported. Use the A/D Start Trigger Input (pin 55) for triggering and gating with `cbAInScan()` and `cbFileAInScan()` / `AInScan()` and `FileAInScan()`. Use the A/D Stop Trigger Input (pin 54) for `cbAPretrig()` and `cbFilePretrig()` / `APretrig()` and `FilePretrig()`.

Analog hardware triggering and gating are supported. `cbSetTrigger()` / `SetTrigger()` are supported for `TRIGABOVE`, `TRIGBELOW`, `GATENEGHYS`, `GATEPOSHYS`, `GATEABOVE`, `GATEBELOW`, `GATEINWINDOW`, `GATEOUTWINDOW`. Use the Analog Trigger Input (pin 56) for analog triggering. Analog thresholds are set relative to the ± 5 V range. For example: a threshold of 0 equates to -5 V, and a threshold of 65535 equates to +4.999847 V.

When using analog trigger feature, one or both of the DACs are used to set the threshold and are unavailable for other functions. If the trigger function requires a single reference (`GATEABOVE`, `GATEBELOW`, `TRIGABOVE`, `TRIGBELOW`) then DAC0 is available. If the trigger function requires two references (`GATEINWINDOW`, `GATEOUTWINDOW`, `GATENEGHYS`, `GATEPOSHYS`) then neither DAC is available for other functions.

Caution! Gating should NOT be used with `BURSTMODE` scans.

Pacing analog output

- Hardware pacing, external or internal clock supported.
- The clock edge used to trigger analog output updates for the external pacer may be rising or falling and is selectable using *InstaCal*.
- `EventData` for `ON_PRETRIGGER` events may not be accurate. In general, this value will be below the actual number of pretrigger samples available in the buffer.

These boards support concurrent analog input and output scans. That is, these boards allow for operations of analog input functions and methods (`cbAInScan()` and `cbAPretrig()` / `AInScan()` and `APretrig()`) and analog output functions and methods (`cbAOutScan()` / `AOutScan()`) to overlap without having to call `cbStopBackground()` between the start of input and output scans.

Output pin 59 configuration

Pin 59 may be configured as the DAC Pacer Output, SSH Output with hold configured as high level, or SSH Output with hold configured as low level. These options are selected via *InstaCal*

PCI- and CIO-DAS6402 and DAS3202 Series

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbAPretrig()`, `cbFileAInScan()`,
 `cbFilePretrig()`

For **PCI-Versions**, the following function also applies:

`cbALoadQueue()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `APretrig()`, `FileAInScan()`, `FilePretrig()`

For **PCI-Versions**, the following method also applies:

`ALoadQueue()`

Analog input argument values

Options `BACKGROUND`, `CONTINUOUS`, `EXTCLOCK`, `CONVERTDATA`, `SINGLEIO`, `BLOCKIO*`,
 `BURSTMODE`, `EXTTRIGGER`

*Packet size: 512 for both CIO- and PCI- boards.

HighChan **PCI-DAS6402 and CIO-DAS6402**
 0 to 63 in single-ended mode, 0 to 31 in differential mode

PCI-DAS3202

0 to 31

Rate	CIO-DAS6402/12	CIO-DAS6402/16	All others
	Up to 330000	Up to 100000	Up to 200000

Range	<code>BIP10VOLTS</code>	<code>UNI10VOLTS</code>
	<code>BIP5VOLTS</code>	<code>UNI5VOLTS</code>
	<code>BIP2PT5VOLTS</code>	<code>UNI2PT5VOLTS</code>
	<code>BIP1PT25VOLTS</code>	<code>UNI1PT25VOLTS</code>

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options `SIMULTANEOUS`
 For **PCI Versions**, the following argument values are also valid:

`BACKGROUND`, `EXTCLOCK`, `CONTINUOUS`

HighChan 1 max

Rate	PCI Versions	CIO Versions
	Up to 100000	Ignored

Range	PCI Versions, CIO-DAS6402/12	CIO-DAS6402/16
	<code>BIP10VOLTS</code>	Ignored - Not programmable
	<code>BIP5VOLTS</code>	
	<code>UNI10VOLTS</code>	
	<code>UNI5VOLTS</code>	

DataValue 0 to 4095

For **PCI-DAS6402/16, PCI-DAS3202/16, CIO-DAS6402/16**, the following additional argument values are also valid: 0 to 65535 (Refer to "16-bit values using a signed integer data type" on page 16 for information on 16-bit values using unsigned integers.)

Digital I/O

Digital I/O functions and methods supported

UL: cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()

For **PCI- Versions**, the following additional function is also valid:
cbDConfigPort()

UL for .NET: DOut(), DIn(), DBitIn(), DBitOut()

For **PCI- Versions**, the following additional method is also valid:
DConfigPort()

Digital I/O argument values

PortNum AUXPORT*

DataValue 0 to 15

BitNum 0 to 3

* AUXPORT is not configurable for these boards.

For **PCI- Versions**, the following additional argument values are also valid:

PortNum FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH

DataValue 0 to 15 for PORTCL or PORTCH;
0 to 255 for PORTA or PORTB

BitNum 0 to 23 for FIRSTPORTA

Counter I/O

Counter functions and methods supported

UL: cbC8254Config(), cbCIn(), cbCLoad()

UL for .NET: C8254Config(), CIn(), CLoad()

Counter argument values

CounterNum 1

Config HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE,
HARDWARESTROBE

LoadValue 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers.)

RegNum: LOADREG1

Triggering

Trigger functions and methods supported

UL: cbSetTrigger()

UL for .NET: SetTrigger()

Trigger argument values

TrigType TRIGPOSEDGE, TRIGNEGEDGE, GATEHIGH, GATELOW

For **PCI- versions**, the following additional argument values are also valid:

TRIGABOVE, TRIGBELOW, GATENEGHYS, GATEPOSHYS, GATEABOVE, GATEBELOW, GATEINWINDOW, GATEOUTWINDOW

Threshold 0 to 4095

For **/16 versions** the following argument values are also valid:

0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers).

Event notification**Event notification functions and methods supported (PCI versions Only)**

UL: cbEnableEvent(), cbDisableEvent()

UL for .NET: EnableEvent(), DisableEvent()

Event notification argument values

EventType ON_SCAN_ERROR, ON_PRETRIGGER, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN, ON_END_OF_AO_SCAN

Hardware considerations**Pacing Analog input**

Hardware pacing, external or internal clock supported. The packet size is 512 samples for both **CIO versions** and for **PCI versions**.

Triggering and gating

Digital (TTL) hardware triggering supported. The **PCI version** also supports analog hardware triggering. Analog thresholds are set relative to the ± 10 V range. For example, a threshold of 0 equates to -10 V and a threshold of 65535 equates to +9.999695 V.

When using the UL functions `cbAPretrig()` or `cbFilePretrig()` (or the UL for .NET methods `APretrig()` or `FilePretrig()`) on the **PCI-DAS6402/16** or **PCI-DAS3202/16**, use the A/D Stop Trigger In (pin 47) input to supply the trigger.

When using both `EXTCLOCK` and `BURSTMODE` on the **PCI-DAS6402/16** or **PCI-DAS3202/16**, use the A/D Start Trigger In (pin 45) input to supply the clock and not the A/D External Pacer (pin 42). Since `BURSTMODE` is actually paced by the internal burst clock, specifying `EXTCLOCK` when using `BURSTMODE` is equivalent to specifying `EXTTRIGGER`.

When using analog trigger feature, one or both of the DACs are used to set the threshold and are unavailable for other functions. If the trigger function requires a single reference (`GATEABOVE`, `GATEBELOW`, `TRIGABOVE`, `TRIGBELOW`) then DAC0 is available. If the trigger function requires two references (`GATEINWINDOW`, `GATEOUTWINDOW`, `GATENEGHYS`, `GATEPOSHYS`), then neither DAC is available for other functions.

Caution! Gating should NOT be used with `BURSTMODE` scans.

Gain queue

When using the UL function `cbALoadQueue()` or the UL for .NET method `ALoadQueue()` with the **PCI version**, up to 8k elements can be loaded into the queue.

Pacing analog output

CIO Version: Software only

PCI Version: Hardware pacing, external or internal clock supported.

Output pin 49 configuration

On the PCI version, pin 49 may be configured as the DAC Pacer Output, SSH Output with hold configured as high level or SSH Output with hold configured as low level. These options are selected via *InstaCal*.

Event notification

The PCI versions of these boards support concurrent analog input and output scans. That is, these boards allow for operations of analog input functions (`cbAInScan()` and `cbAPretrig()`) and analog output functions (`cbAOutScan()`) to overlap without having to call `cbStopBackground()` between the start of input and output scans. Equivalent UL for .NET methods are `AInScan()`, `APretrig()`, `AOutScan()` and `StopBackground()`.

PCI-DAS1602, PCI-DAS1200 & PCI-DAS1000 Series

Analog input

Analog input functions and methods supported

UL:	cbAIn(), cbAInScan(), cbATrig(), cbAPretrig(), cbFileAInScan(), cbFilePretrig()
UL for .NET:	AIn(), AInScan(), ATrig(), APretrig(), FileAInScan(), FilePretrig()

Analog input argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, BLOCKIO, BURSTMODE, EXTTRIGGER
HighChan	0 to 15 in single-ended mode, 0 to 7 in differential mode
Rate	PCI-DAS1602/12, PCI-DAS1200, PCI-DAS1200/JR Up to 330000 PCI-DAS1000 Up to 250000 PCI-DAS1602/16, PCI-DAS1002 Up to 200000 PCI-DAS1001 Up to 150000
Range	PCI-DAS1602/12, PCI-DAS1602/16, PCI-DAS1200, PCI-DAS1200Jr, PCI-DAS1002, PCI-DAS1000 BIP10VOLTS UNI10VOLTS BIP5VOLTS UNI5VOLTS BIP2PT5VOLTS UNI2PT5VOLTS BIP1PT25VOLTS UNI1PT25VOLTS PCI-DAS1001 BIP10VOLTS UNI10VOLTS BIP1VOLTS UNI1VOLTS BIPPT1VOLTS UNIPPT1VOLTS BIPPT01VOLTS UNIPPT01VOLTS

Analog output

Excludes **PCI-DAS1200Jr**.

Analog output functions and methods supported

UL:	cbAOut(), cbAOutScan()
UL for .NET:	AOut(), AOutScan()

Analog output argument values

Options	SIMULTANEOUS		
	For PCI-DAS1602 Series , the following argument values are also valid: BACKGROUND, CONTINUOUS, EXTCLOCK		
HighChan	0 to 1		
Rate	PCI-DAS1602/16 Up to 100000	PCI-DAS1602/12 Up to 250000	All others Ignored
Range	BIP10VOLTS BIP5VOLTS	UNI10VOLTS UNI5VOLTS	

DataValue 0 to 4095

For **PCI-DAS1602/16**, the following argument values are also valid: 0 to 65535
(Refer to "[16-bit values using a signed integer data type](#)" on page 16 for
information on 16-bit values using unsigned integers.)

Digital I/O

Digital I/O functions and methods supported

UL: cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

UL for .NET: DOut(), DIn(), DBitIn(), DBitOut(), DConfigPort()

Digital I/O argument values

PortNum FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH

DataValue 0 to 15 for PORTCL or PORTCH
0 to 255 for PORTA or PORTB

BitNum 0 to 23 for FIRSTPORTA

Counter I/O

Counter functions and methods supported

UL: cbC8254Config(), cbCIn(), cbCLoad()

UL for .NET: C8254Config(), CIn(), CLoad()

Counter argument values

CounterNum 4 to 6

Config HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE,
HARDWARESTROBE

LoadValue 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for
information on 16-bit values using unsigned integers.)

RegNum: LOADREG4, LOADREG5, LOADREG6

Triggering

PCI-DAS1602/16 and PCI-DAS1602/12 only

Trigger functions and methods supported

UL: cbSetTrigger()

UL for .NET: SetTrigger()

Trigger argument values

TrigType TRIGPOSEDGE, TRIGNEGEDGE, TRIGABOVE, TRIGBELOW, GATEHIGH, GATELOW,
GATENEGHYS, GATEPOSHYS, GATEABOVE, GATEBELOW, GATEINWINDOW, GATEOUTWINDOW

Threshold **PCI-DAS1602/16:** 0 to 65535
PCI-DAS1602/12: 0 to 4095

Event notification

Event notification functions and methods supported

PCI Versions Only

UL: `cbEnableEvent()`, `cbDisableEvent()`

UL for .NET: `EnableEvent()`, `DisableEvent()`

Event notification argument values

EventType `ON_SCAN_ERROR`, `ON_PRETRIGGER`, `ON_DATA_AVAILABLE`, `ON_END_OF_AI_SCAN`

For **PCI-DAS1602/16** and **PCI-DAS1602/12** the following argument values are also valid:

`ON_END_OF_AO_SCAN`

Hardware considerations

Pacing analog input

Hardware pacing, external or internal clock supported.

The clock edge used to trigger acquisition for the external pacer may be *rising* or *falling*, and is selectable using *InstaCal*.

For the **PCI-DAS1602/16**, the packet size is 256 samples. All others in this series have a packet size of 512 samples.

Analog input configuration

The analog input mode is selectable via *InstaCal* for either 8-channel differential or 16-channel single-ended.

Triggering and gating - PCI-DAS1602 Series

Digital (TTL) and analog hardware triggering supported.

Analog thresholds are set relative to the ± 10 V range. For example: a threshold of 0 equates to -10 V. Thresholds of 65535 and 4095 correspond to +9.999695 and +9.995116 V for the 16-bit and 12-bit boards, respectively.

When using analog trigger feature, one or both of the DACs are unavailable for other functions. If the trigger function requires a single reference (`GATE_ABOVE`, `GATE_BELOW`, `TRIGABOVE`, and `TRIGBELOW`), DAC0 is available. If the trigger function requires two references (`GATE_IN_WINDOW`, `GATE_OUT_WINDOW`, `GATE_NEG_HYS` and `GATE_POS_HYS`), neither DAC is available for other functions.

Triggering and gating - PCI-DAS1200, PCI-DAS1000 Series

Digital (TTL) hardware triggering supported.

Concurrent operations - PCI-DAS1602 Series

Concurrent analog input and output scans supported. That is, PCI-DAS1602 Series boards allow for operations of analog input functions (`cbAInScan()` and `cbAPretrig()`) and analog output functions (`cbAOutScan()`) to overlap without having to call `cbStopBackground()` between the start of input and output scans. Equivalent UL for .NET methods are `AInScan()`, `APretrig()`, `AOutScan()`, and `StopBackground()`.

Pacing analog output - PCI-DAS1602 Series

Hardware pacing, external or internal clock supported.

The clock edge used to trigger analog output updates for the external pacer may be rising or falling and is selectable using *InstaCal*.

Counters

The source for counter 4 may be internal or external and is selectable using *InstaCal*.

Although counters 4, 5 and 6 are programmable through the counter functions, the primary purpose for some of these counters may conflict with these functions.

Potential conflicts include:

- **PCI-DAS1200, PCI-DAS1000 Series:** Counters 5 and 6 are always available to the user. Counter 4 is used as a residual counter by some of the analog input functions and methods.
- **PCI-DAS1602 Series:** Counters 5 and 6 are used as DAC pacers by some analog output functions and methods. Counter 4 is used as a residual counter by some of the analog input functions and methods.

PCIM-DAS1602 and PCIM-DAS16JR Series

Analog input

Analog input functions and methods supported

UL: `cbAIn(), cbAInScan(), cbFileAInScan(), cbATrig()`

UL for .NET: `AIn(), AInScan(), FileAInScan(), ATrig()`

Analog input argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, BLOCKIO, BURSTMODE, EXTTRIGGER	
HighChan	0 to 15 in single-ended mode, 0 to 7 in differential mode	
Rate	100000	
Range	BIP10VOLTS UNI10VOLTS	
	BIP5VOLTS UNI5VOLTS	
	BIP2PT5VOLTS UNI2PT5VOLTS	
	BIP1PT25VOLTS UNI1PT25VOLTS	

Analog output (PCIM-DAS1602/16 only)

Analog output functions and methods supported

UL: `cbAOut(), cbAOutScan()`

UL for .NET: `AOut(), AOutScan()`

Analog output argument values

Options	Ignored
HighChan	1 max
Count	2
Rate	Ignored
Range	Ignored - Not programmable
DataValue	0 to 4095

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()`

UL for .NET: `DOut(), DIn(), DBitIn(), DBitOut()`

The PCIM-DAS1602/16 also supports:

UL: `cbDConfigPort()`

UL for .NET: `DConfigPort()`

Digital I/O argument values

PortNum: AUXPORT*

The PCIM-DAS1602/16 also supports:

PortNum: FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH

DataValue: 0 to 15 FIRSTPORTCL, FIRSTPORTCH or AUXPORT*

0 to 255 for FIRSTPORTA or FIRSTPORTB

BitNum: 0 to 23 for FIRSTPORTA

0 to 3 for AUXPORT*

*AUXPORT is not configurable for these boards.

Counter I/O**Counter functions and methods supported**

UL: cbC8254Config(), cbCIn(), cbCLoad()

UL for .NET: C8254Config(), CIn(), CLoad()

Counter argument values

CounterNum 1 to 3

Config HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE

LoadValue 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers.)

RegNum: LOADREG1, LOADREG2, LOADREG3

Event notification**Event notification functions and methods supported**

UL: cbEnableEvent(), cbDisableEvent()

UL for .NET: EnableEvent(), DisableEvent()

Event notification argument values

EventType ON_SCAN_ERROR, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN

Triggering**Trigger functions and methods supported**

UL: cbSetTrigger()

UL for .NET: SetTrigger()

Trigger argument values

TrigType TRIGPOSEDGE, TRIGNEGEDGE, GATEHIGH, GATELOW

Hardware considerations**Pacing analog input**

Hardware pacing, external or internal clock supported.

Analog input ranges

For the **PCIM-DAS1602/16**, the A/D ranges are configured with a combination of a switch (Unipolar / Bipolar) and a programmable gain code. The state of this switch is set in the configuration file using *InstaCal*. After the UNI/BIP switch setting is selected, only matching ranges can be used in Universal Library programs.

Triggering and gating

Digital (TTL) hardware triggering supported.

Pacing analog output

Software pacing only

CIO-DAS800 Series

Analog input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, BLOCKIO, EXTTRIGGER

HighChan 0 to 7

Rate **CIO-DAS802/16**
100000

All others in series
50,000

Range **CIO-DAS800**
Ignored - Not programmable.

CIO-DAS801 supports the following A/D ranges

BIP10VOLTS	UNI10VOLTS
BIP5VOLTS	UNI1VOLTS
BIP1VOLTS	UNIP1VOLTS
BIPPT5VOLTS	UNIP1PT01VOLTS
BIPPT05VOLTS	
BIPPT01VOLTS	

CIO-DAS802 supports the following A/D ranges

BIP10VOLTS	UNI10VOLTS
BIP5VOLTS	UNI5VOLTS
BIP2PT5VOLTS	UNI2PT5VOLTS
BIP1PT25VOLTS	UNI1PT25VOLTS
BIPPT625VOLTS	

CIO-DAS802/16 supports the following A/D ranges

BIP10VOLTS	UNI10VOLTS
BIP5VOLTS	UNI5VOLTS
BIP2PT5VOLTS	UNI2PT5VOLTS
BIP1PT25VOLTS	UNI1PT25VOLTS

Analog Output

These boards do not have D/A converters and do not support analog output functions.

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`

Digital I/O argument values

PortNum AUXPORT (not configurable for these boards)

DataValue `cbDOut()` `cbDIn()`
0 to 15 0 to 7

BitNum `cbDOut()` `cbDIn()`
0 to 3 0 to 2

Counter I/O

Counter functions and methods supported

UL: `cbC8254Config()`, `cbCIn()`, `cbCLoad()`

UL for .NET: `C8254Config()`, `CIn()`, `CLoad()`

Counter argument values

CounterNum 1 to 3

Config HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE

LoadValue 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers.)

RegNum: LOADREG1, LOADREG2, LOADREG3

Hardware considerations

Pacing analog input

Hardware pacing, external or internal clock supported.

The packet size is 128 samples. Note that digital output is not compatible with concurrent `cbAInScan()` / `AInScan()` operation, since the channel multiplexer control shares the register with the digital output control. Writing to this register during a scan may adversely affect the scan.

Triggering and gating

Digital hardware triggering supported.

CIO-, PCI-, and PC104-DAS08 Series

Analog input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, EXTTRIGGER

HighChan 0 to 7

Rate From 63 up to 50000 (Refer to the "[Sampling Rate using SINGLEIO](#)" on page 30.)

Range

DAS08 series

Since the **DAS08** series does not have programmable gain, the Range arguments for the analog input functions are ignored.

PCI-DAS08

BIP5VOLTS (± 5 V)

CIO-DAS08 and PC104-DAS08

BIP10VOLTS UNI10VOLTS

BIP5VOLTS

CIO-DAS08-PGH and CIO-DAS08-AOH

BIP10VOLTS UNI10VOLTS

BIP5VOLTS UNI1VOLTS

BIP1VOLTS UNIP1VOLTS

BIPPT5VOLTS UNIPPT01VOLTS

BIPPT1VOLTS BIPPT01VOLTS

BIPPT05VOLTS BIPPT005VOLTS

CIO-DAS08-PGL and CIO-DAS08-AOL

BIP10VOLTS UNI10VOLTS

BIP5VOLTS UNI5VOLTS

BIP2PT5VOLTS UNI2PT5VOLTS

BIP1PT25VOLTS UNI1PT25VOLTS

BIPPT625VOLTS

CIO-DAS08-PGM and CIO-DAS08-AOM

BIP10VOLTS UNI10VOLTS

BIP5VOLTS UNI1VOLTS

BIPPT5VOLTS UNIPPT1VOLTS

BIPPT1VOLTS UNIPPT01VOLTS

BIPPT05VOLTS

Analog output

AO, -AOH, -AOM, -AOL versions only

Analog output functions and methods supported

UL: `cbAOut()`, `AOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options SIMULTANEOUS

HighChan 1 max

Rate Ignored

Count	2 max
Range	Ignored - Not programmable
DataValue	0 to 4095

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut (), cbDIn (), cbDBitIn (), cbDBitOut ()`

UL for .NET: `DOut (), DIn (), DBitIn (), DBitOut ()`

For **CIO-DAS08** and **CIO-DAS08-AOx**, the following function and method is also supported:

UL: `cbDConfigPort ()`

UL for .NET: `DConfigPort ()`

Digital I/O argument values

PortNum `AUXPORT`

DataValue 0 to 15 using `cbDOut ()` or `DOut ()`

0 to 7 using `cbDIn ()` or `DIn ()`

BitNum 0 to 3 using `cbDBitOut ()` or `DBitOut ()`

0 to 2 using `cbDBitIn ()` or `DBitIn ()`

For **CIO-DAS08** and **CIO-DAS08-AOx** the following argument values are also valid:

`FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH`

PortNum 0 to 15 for `FIRSTPORTCL` or `FIRSTPORTCH`

0 to 255 for `FIRSTPORTA` or `FIRSTPORTB`

DataValue 0 to 15 for `FIRSTPORTCL` or `FIRSTPORTCH`

0 to 255 for `FIRSTPORTA` or `FIRSTPORTB`

BitNum 0 to 23 for `FIRSTPORTA`

Counter I/O

Counter functions and methods supported

UL: `cbC8254Config (), cbCIn (), cbCLoad ()`

UL for .NET: `C8254Config (), CIn (), CLoad ()`

Counter argument values

CounterNum 1 to 3

Config `HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE`

LoadValue 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers.)

RegNum: `LOADREG1, LOADREG2, LOADREG3`

Hardware considerations

Pacing analog input

Hardware pacing, external or internal clock supported.

Before using the `cbAInScan()` function or the `AInScan()` method for timed analog input with a **CIO-** or **PC104-** series board, the output of counter 1 must be wired to the Interrupt input; if you have a **CIO-DAS08** board revision 3 or higher, a jumper is provided on the board to accomplish this. An interrupt level must have been selected in *InstaCal* and the *CB.CFG* file saved.

Triggering and gating

Polled digital input triggering (TTL) supported. Refer to "[Trigger support](#)" on page 29 for more information. Use pin 25 as the trigger input.

Pacing analog output

Software pacing only

Digital Output

Since the channel settings and DOut bits share a register, attempting to change the digital output value during an analog input scan may result in no change or unexpected values in digital output ports.

CIO-DAS08/Jr and CIO-DAS08/Jr/16 Series

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options	CONVERTDATA
HighChan	0 to 7
Rate	Ignored
Range	Since these boards do not have programmable gain, the Range arguments for the analog input functions are ignored.

Analog output

(If optional D/A converters are installed)

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options	SIMULTANEOUS
HighChan	1 max
Rate	Ignored
Count	2 max
Range	Ignored - Not programmable; fixed at BIP5VOLTS (± 5 V)
DataValue	0 to 4095

For CIO-DAS08/Jr/16-AO, the following argument values are also valid:
0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers.)

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`

Digital I/O argument values

PortNum	AUXPORT*
DataValue	0 to 255
BitNum	0 to 7

* AUXPORT is not configurable for these boards.

Counter I/O

Counter functions and methods supported

None

Hardware considerations

Pacing analog input

Software pacing only

PCM-DAS08

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, NOTODINTS, EXTTRIGGER, NOCALIBRATEDATA
HighChan	0 to 7
Rate	25000 max. For other restrictions, refer to the PCM-DAS08 User's Manual at www.mccdaq.com/PDFmanuals/pcm-das08.pdf .
Range	This board does not have programmable gain, so the Range argument to analog input functions is ignored.

Digital I/O

Digital I/O functions and methods supported

UL: `cbDIn()`, `cbDOut()`, `cbDBitIn()`, `cbDBitOut()`

UL for .NET: `DIn()`, `DOut()`, `DBitIn()`, `DBitOut()`

Digital I/O argument values

PortNum	AUXPORT
DataValue	0 to 7
BitNum	0 to 2

Hardware considerations

Pacing analog input

Internal or external clock

Maximizing sampling rates

When paced by the onboard clock, the rate is set by an onboard oscillator running at 25 kHz. The oscillator output may be divided by 2, 4 or 8, resulting in rates of 12.5 kHz, 6.25 kHz or 3.13 kHz. When pacing a single channel from the onboard clock, these are the four choices of rate available. When a rate is requested within the range of 3000 to 25000, the library selects the closest of the four available rates.

Scanning more than one channel divides the rate requested among the number of channels requested. The maximum rate when scanning eight channels is 3130 (25000 divided by eight channels).

PPIO-AI08

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options `CONVERTDATA`

HighChan `0 to 7`

Rate Ignored

Range This board does not have programmable gain, so the Range arguments for the analog input functions are ignored.

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`

Digital I/O argument values

PortNum `AUXPORT*`

DataValue	<code>cbDOut()</code>	<code>cbDIn()</code>
	<code>0 to 15</code>	<code>0 to 7</code>

BitNum	<code>cbDOut()</code>	<code>cbDIn()</code>
	<code>0 to 3</code>	<code>0 to 2</code>

* `AUXPORT` is not configurable for this board.

Hardware considerations

Pacing analog input

Software pacing only

CIO- and PC104-DAS16

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

The **DAS16/330**, **DAS16/330i**, **DAS16/M1**, and **DAS16/M1/16** also support:

UL: `cbAPretrig()`, `cbFileAInScan()`, `cbFilePretrig()`

UL for .NET: `APretrig()`, `FileAInScan()`, `FilePretrig()`

The **DAS16/330i** and **DAS16/M1** also support:

UL: `cbALoadQueue()`

UL for .NET: `cbALoadQueue()`

Analog input argument values

Options `BACKGROUND`, `CONTINUOUS`, `EXTCLOCK`, `CONVERTDATA`, `EXTTRIGGER`

For **DAS16/330**, **DAS16/330i**, **DAS16/M1** and **DAS16/M1/16**, the following argument values are also valid:

`DTCONNECT`, `BLOCKIO` (packet size: 512), `EXTMEMORY`

For **DAS16**, **DAS16/F**, **DAS16/Jr**, **DAS16/Jr/16** and **PC104-DAS16Jr** series, the following argument values are also valid:

`SINGLEIO`, `DMAIO`

For **DAS16/M1/16**, the following argument value is also valid:

`BURSTMODE`

HighChan **DAS16/M1** and **DAS16/M1/16**
0 to 7

All others

0 to 15 in single-ended mode, 0 to 7 in differential mode

Rate	DAS16/M1 & DAS16/M1/16	DAS16/330 & 330i
	Up to 1000000	Up to 330000
	PC104-DAS16Jr/12	CIO-DAS16Jr
	Up to 160000	Up to 130000

DAS16/F & DAS16Jr/16	CIO-DAS16
Up to 100000	Up to 50000

Range **CIO-DAS16 & CIO-DAS16/F**

These boards do not have programmable gain so the `Range` argument to analog input functions is ignored.

All other boards in this series support the following ranges:

<code>BIP5VOLTS</code>	<code>UNI10VOLTS</code>
<code>BIP2PT5VOLTS</code>	<code>UNI5VOLTS</code>
<code>BIP1PT25VOLTS</code>	<code>UNI2PT5VOLTS</code>
	<code>UNI1PT25VOLTS</code>

For all programmable gain boards in this series **except** the **DAS16/M1/16**, the following argument value is also valid:

`BIP10VOLTS`

For all programmable gain boards in this series **except** the **CIO-DAS16Jr/16** and **PC104-DAS16Jr/16**, the following argument value is also valid:
BIPPT625VOLTS

Analog output

CIO-DAS16 & CIO-DAS16/F only

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`
UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options	SIMULTANEOUS
HighChan	1 max
Rate	Ignored
Count	2 max
Range	Ignored - Not programmable
DataValue	0 to 4095

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`
UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`

The **CIO-DAS16 & 16/F**, **CIO-DAS16/M1** and **CIO-DAS16/M1/16**, the following function is also supported:

UL: `cbDConfigPort()`
UL for .NET: `DConfigPort()`

Digital I/O argument values

PortNum	AUXPORT*
DataValue	0 to 15
BitNum	0 to 3

* AUXPORT is not configurable for these boards.

For **CIO-DAS16 & 16/F**, **CIO-DAS16/M1** and **CIO-DAS16/M1/16** the following additional argument values are also valid:

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for FIRSTPORTCL or FIRSTPORTCH 0 to 255 for FIRSTPORTA or FIRSTPORTB
BitNum	0 to 23 for FIRSTPORTA

Counter I/O

Counter functions and methods supported

UL: `cbC8254Config()`, `cbCIn()`, `cbCLoad()`

UL for .NET: `C8254Config()`, `CIn()`, `CLoad()`

Counter argument values

CounterNum 1 to 3

The **CIO-DAS16/M1/16** also supports these argument values:
4 to 6

Config HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE,
HARDWARESTROBE

LoadValue 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for
information on 16-bit values using unsigned integers.)

RegNum: LOADREG1, LOADREG2, LOADREG3

For **CIO-DAS16/M1/16** the following argument values are also valid
LOADREG4, LOADREG5, LOADREG6

Triggering (CIO-DAS16/M1/16 only)

Trigger functions and methods supported

UL: `cbSetTrigger()`

UL for .NET: `SetTrigger()`

Trigger argument values

TrigType TRIGPOSEDGE, TRIGNEGEDGE, GATEHIGH, GATELOW

Threshold 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for
information on 16-bit values using unsigned integers.)

Hardware considerations

Pacing analog input

- Hardware pacing, external or internal clock supported.
- The packet size is 512 samples
- The DMAIO option cannot be used while using the chan/gain queue on the **DAS-330i** board.

CIO-DAS16/M1

If you use the timed analog functions with the **CIO-DAS16/M1** board to acquire more than 2048 data points, you may not be able to achieve the full 1 MHz rate. On slow machines, these functions may hang if the scan rate is fast, generally in the range of 500 to 700 kHz.

Determine the maximum rate by passing in different high rates until the maximum rate is achieved without hanging the system. If the full 1.0 MHz rate is required, add a **MEGA FIFO** memory board and specify the EXTMEMORY option on the call to `cbAInScan()` or `AInScan()`.

CIO-DAS16/M1/16 also supports counter numbers 4 through 6, with counter 4 being the only independent user counter.

Triggering and gating

- For the **CIO-DAS16/M1/16**, Digital (TTL) and analog hardware triggering is supported.

- For **all others in this series**, digital (TTL) polled gate triggering is supported. Refer to "[Trigger support](#)" on page 29

Pacing analog output

Software only

PCM- and PC-CARD-DAS16 Series

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options `BACKGROUND`, `CONTINUOUS*`, `EXTCLOCK`, `CONVERTDATA`, `SINGLEIO`, `BLOCKIO`,
`EXTTRIGGER`, `NOTODINTS`, `NOCALIBRATEDATA`

The **PC-CARD-DAS16** series also supports `BURSTMODE`.

HighChan **DAS16/S and DAS16/330**

0 to 15

DAS16/D

0 to 7

Rate **DAS16/330**

330000

PC-CARD-DAS16/16

200000

All others in series

100000

Range For **DAS16x/12**, the following A/D ranges are valid:

`BIP10VOLTS` `UNI10VOLTS`

`BIP5VOLTS` `UNI5VOLTS`

`BIP2PT5VOLTS` `UNI2PT5VOLTS`

`BIP1PT25VOLTS` `UNI1PT25VOLTS`

For **DAS16x/16**, the following A/D ranges are valid:

`BIP10VOLTS` `BIP5VOLTS`

`BIP2PT5VOLTS` `BIP1PT25VOLTS`

For **DAS16/330**, the following A/D ranges are valid:

`BIP10VOLTS` `BIP5VOLTS`

Analog output

PCM-DAS16D/12AO and **PC-CARD-DAS16/xx-AO** only

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options `SIMULTANEOUS` (**PCM** version only)

HighChan 1 max

Rate	Ignored
Count	2 max
Range	Ignored - Not programmable; fixed at BIP10VOLTS (± 10 V) For PC-CARD-DAS16/12AO and PCM-DAS16D/12AO , the following argument values are also valid: BIP10VOLTS BIP5VOLTS
DataValue	0 to 4095 For PC-CARD-DAS16/16AO , the following argument values are also valid: 0 to 65535 (Refer to " 16-bit values using a signed integer data type " on page 16.)

Digital I/O

Digital I/O functions and methods supported

UL:	cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()
UL for .NET:	DOut(), DIn(), DBitIn(), DBitOut(), DConfigPort()

Digital I/O argument values

PortNum	PC-CARD-DAS16/xxAO FIRSTPORTA All others in this series: FIRSTPORTA, FIRSTPORTB
DataValue	PC-CARD-DAS16/xxAO 0 to 15 for FIRSTPORTA All others in this series: 0 to 15 for FIRSTPORTA or FIRSTPORTB
BitNum	PC-CARD-DAS16/xxAO 0 to 3 for FIRSTPORTA All others in this series: 0 to 7 for FIRSTPORTA

Counter I/O

Counter functions and methods supported

UL:	cbC8254Config(), cbCIn(), cbCLoad()
UL for .NET:	C8254Config(), CIn(), CLoad()

Counter argument values

CounterNum	1 to 3
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (Refer to " 16-bit values using a signed integer data type " on page 16 for information on 16-bit values using unsigned integers.)
RegNum:	LOADREG1, LOADREG2, LOADREG3

Triggering

PC-Card Only

Trigger functions and methods supported

UL: `cbSetTrigger()`

UL for .NET: `SetTrigger()`

Trigger argument values

TrigType `TRIGPOSEDGE, TRIGNEGEDGE, GATEHIGH, GATELOW` (All at A/D External trigger input)

Hardware considerations

Pacing analog input

- Internal or external clock
- The packet size is 256 samples for **PCM** boards; 2048 samples for **PC-CARD** boards.
For `CONTINUOUS` mode scans, the sample count should be at least one packet size (≥ 2048 samples) for the **PC-CARD**- boards.

These cards do not have residual counters, so `BLOCKIO` transfers must acquire integer multiples of the packet size before completing the scan. This can be lengthy for the **PC-CARDs** which must acquire 2048 samples between interrupts for `BLOCKIO` transfers. In general, it is best to allow the library to determine the best transfer mode (`SINGLEIO` vs. `BLOCKIO`) for these boards.

Triggering and gating

- External digital (TTL) polled gate trigger supported on **PCM** versions. Refer to "[Trigger support](#)" on page 29.
- External digital (TTL) hardware trigger supported on **PC-CARD** versions.

CIO-DAS1400 and CIO-DAS1600 Series

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options `BACKGROUND`, `CONTINUOUS`, `EXTCLOCK`, `CONVERTDATA`, `SINGLEIO`, `DMAIO`, `BURSTMODE`, `EXTTRIGGER`

For **CIO-DAS1600**, the following argument values are also valid:
`DTCONNECT`, `EXTMEMORY`.

HighChan 0 to 15 in single-ended mode, 0 to 7 in differential mode

Rate **DAS1401/12, DAS1402/12, DAS1601/12, DAS1602/12**
160000

DAS1602/16, DAS1402/16

100000

DAS1401/12, DAS1402/12, DAS1601/12, DAS1602/12 to external memory
330000

Range **CIO-DAS1402, CIO-DAS1602, CIO-DAS1402/16 and CIO-DAS1602/16**

<code>BIP10VOLTS</code>	<code>UNI10VOLTS</code>
<code>BIP5VOLTS</code>	<code>UNI5VOLTS</code>
<code>BIP2PT5VOLTS</code>	<code>UNI2PT5VOLTS</code>
<code>BIP1PT25VOLTS</code>	<code>UNI1PT25VOLTS</code>

CIO-DAS1401 and CIO-DAS1601

<code>BIP10VOLTS</code>	<code>UNI10VOLTS</code>
<code>BIP1VOLTS</code>	<code>UNI1VOLTS</code>
<code>BIPPT1VOLTS</code>	<code>UNIPT1VOLTS</code>
<code>BIPPT01VOLTS</code>	<code>UNIPT01VOLTS</code>

Analog output (CIO-DAS1600 series only)

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options `SIMULTANEOUS`

HighChan 1 max

Count 2 max

Rate Ignored

Pacing Software pacing only

Range Analog output gain is not programmable, so the Range argument is ignored.

DataValue 0 to 4095

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`

For **DAS1600**, the following function and method are also valid:

UL: `cbDConfigPort()`

UL for .NET: `DConfigPort()`

Digital I/O argument values

PortNum `AUXPORT*`

DataValue `0 to 15`

BitNum `0 to 3`

* `AUXPORT` is not configurable for these boards.

For **DAS1600**, the following additional argument values are also valid:

PortNum `FIRSTPORTA`, `FIRSTPORTB`, `FIRSTPORTCL`, `FIRSTPORTCH`

DataValue `0 to 15` for `FIRSTPORTCL` or `FIRSTPORTCH`;
 `0 to 255` for `FIRSTPORTA` or `FIRSTPORTB`

BitNum `0 to 23` for `FIRSTPORTA`

Counter I/O

Counter functions and methods supported

UL: `cbC8254Config()`, `cbCIn()`, `cbCLoad()`

UL for .NET: `C8254Config()`, `CIn()`, `CLoad()`

Counter argument values

CounterNum `1 to 3`

Config `HIGHONLASTCOUNT`, `ONESHOT`, `RATEGENERATOR`, `SQUAREWAVE`, `SOFTWARESTROBE`,
 `HARDWARESTROBE`

LoadValue `0 to 65535` (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for
 information on 16-bit values using unsigned integers.)

RegNum: `LOADREG1`, `LOADREG2`, `LOADREG3`

Hardware considerations

Pacing analog input

Hardware pacing, external or internal clock supported.

Specifying `SINGLEIO` while also specifying `BURSTMODE` is not recommended. If this combination is used, the Count value should be set as low as possible, preferably to the number of channels in the scan. Otherwise, overruns may occur.

When `EXTMEMORY` is used with the **CIO-DAS1600** the `cbGetStatus()` function or `GetStatus()` method does not return the current count and current index. This is a limitation imposed by maintaining identical registers to the **KM-DAS1600**.

Triggering and gating

External digital (TTL) polled gate trigger supported. Refer to "[Trigger support](#)" on page 29.

Range

The **CIO-DAS1400** and **CIO-DAS1600** A/D ranges are configured with a combination of a switch (Unipolar / Bipolar) and a programmable gain code. The state of this switch is set in the configuration file using *InstaCal*. After the UNI/BIP switch setting is selected, only matching ranges can be used in Universal Library programs.

CIO-DAS48/PGA

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options `CONVERTDATA`

HighChan 47 (23 differential)

Rate This board does not have a timer, so the `Rate` argument to the analog scanning functions is ignored.

Range The board may be configured with a jumper for either voltage or current input.

In voltage mode

<code>BIP10VOLTS</code>	<code>UNI10VOLTS</code>
<code>BIP5VOLTS</code>	<code>UNI5VOLTS</code>
<code>BIP2PT5VOLTS</code>	<code>UNI2PT5VOLTS</code>
<code>BIP1PT25VOLTS</code>	<code>UNI1PT25VOLTS</code>
<code>BIPPT625VOLTS</code>	

In current mode

<code>MA4TO20</code>	<code>MA2TO10</code>
<code>MA1TO5</code>	<code>MAPT5TO2PT5</code>

Analog output

Analog output functions and methods supported

The **CIO-DAS48/PGA** board does not support any of the analog output functions.

Digital I/O

Digital I/O functions and methods supported

The **CIO-DAS48/PGA** does not support any of the digital I/O functions.

Counter I/O

Counter functions and methods supported

The **CIO-DAS48/PGA** does not support any of the counter I/O functions.

miniLAB 1008

The miniLAB 1008 supports the following UL and UL for .NET features.

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbALoadQueue()` *, `cbFileAInScan()`, `cbATrig()`

UL for .NET: `AIn()`, `AInScan()`, `ALoadQueue()` *, `FileAInScan()`, `ATrig()`

*The channel-gain queues are limited to eight channel-gain pairs.

Analog input argument values

Options BACKGROUND, BLOCKIO***, BURSTIO**, CONTINUOUS, EXTTRIGGER, CONVERTDATA, and NOCALIBRATEDATA.

**BURSTIO cannot be used with the CONTINUOUS option.

** BURSTIO can only be used with sample count scans of 4096 or less.

*** The BLOCKIO packet size is 64 samples wide.

HighChan 0 to 7 in single-ended mode, 0 to 3 in differential mode.

Rate 8000 maximum for BURSTIO mode (1200 maximum for all other modes.)

When using `cbAInScan()` or `AInScan()`, the minimum rate is 100 S/s aggregate.

Range **Single-ended mode:**

BIP10VOLTS (± 10 V)

Differential mode:

BIP20VOLTS	(± 20 V)	BIP2PT5VOLTS	(± 2.5 V)
BIP10VOLTS	(± 10 V)	BIP2VOLTS	(± 2 V)
BIP5VOLTS	(± 5 V)	BIP1PT25VOLTS	(± 1.25 V)
BIP4VOLTS	(± 4 V)	BIP1VOLTS	(± 1 V)

Pacing Hardware pacing, internal clock supported.

Triggering

Trigger functions and methods supported

UL: `cbSetTrigger()`

UL for .NET: `SetTrigger()`

Trigger argument values

TrigType TRIGHIGH, TRIGLOW

Digital (TTL) hardware triggering supported. The hardware trigger is source selectable via *InstaCal* (AUXPORT inputs 0–3).

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

HighChan	1
Range	Ignored - Not programmable; fixed at UNI5VOLTS (0 to 5 V)
DataValue	0 to 1023

Digital I/O**Configuration functions, methods, and argument values supported**

UL:	cbDConfigBit(), cbDConfigPort()
UL for .NET:	DConfigBit(), DConfigPort()
PortNum	AUXPORT*, FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
PortType	AUXPORT*

* Only AUXPORT is bitwise configurable on this board, and must be configured using cbDConfigBit() or cbDConfigPort() (or the UL for .NET methods DConfigBit() or DConfigPort()) before use for output.

Port I/O functions, methods, and argument values supported

UL:	cbDIn(), cbDOut()
UL for .NET:	DIn(), DOut()
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH, AUXPORT
DataValue	0 to 15 for AUXPORT, FIRSTPORTCL or FIRSTPORTCH 0 to 255 for FIRSTPORTA or FIRSTPORTB

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn(), cbDBitOut()
UL for .NET:	DBitIn(), DBitOut()
PortType	AUXPORT, FIRSTPORTA
BitNum	0 to 3 on AUXPORT 0 to 23 on FIRSTPORTA

Counter I/O**Counter I/O functions and methods supported**

UL:	cbCIn(), cbCIn32(), cbCLoad(), cbCLoad32(), **
UL for .NET:	CIn(), CIn32(), CLoad(), CLoad32(), **

*Although cbCIn() and CIn() are valid for use with this counter, cbCIn32() or CIn32() may be more appropriate. The values returned may be greater than the data types that are used by cbCIn() and CIn() can handle.

**cbCLoad(), CLoad32(), CLoad() and CLoad32() only accept Count=0. These functions are used to reset the counter.

Counter I/O argument values

CounterNum	1
Count:	$2^{32}-1$ when reading the counter.
LoadValue	0 when loading the counter.

`cbCLoad()` and `cbCLoad32()` / `CLoad()` and `CLoad32()` are only used to reset the counter for this board to 0. No other values are valid.

The “[Basic signed integers](#)” guidelines on page 140 apply when using `cbCIn()` or `CIn()` for values greater than 32767, and when using `cbCIn32()` or `CIn32()` for values greater than 2147483647.

RegNum:	LOADREG1
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Event notification**Even notification functions and methods supported**

UL:	<code>cbEnableEvent()</code> , <code>cbDisableEvent()</code>
UL for .NET:	<code>EnableEvent()</code> , <code>DisableEvent()</code>
Event types:	<code>ON_SCAN_ERROR</code> , <code>ON_DATA_AVAILABLE</code> , <code>ON_END_OF_AI_SCAN</code>

Hardware considerations**Resolution**

When configured for single-ended mode, the resolution of the data is 11-bits (data values between 0 and 2047). However, the Universal Library maps this data to 12-bit values, so the range of data is no different from the differential configuration. Consequently, the data returned contains only even numbers between 0 and 4094 when the `NOCALIBRATEDATA` option is used.

BURSTIO

Allows higher sampling rates (up to 8000 Hz) for sample counts up to 4096. Data is collected into the miniLAB 1008's local FIFO. Data is collected into the USB device's local FIFO. Data transfers to the PC don't occur until the scan completes. For `BACKGROUND` scans, the `Count` and `Index` returned by `cbGetStatus()` and `GetStatus()` remain 0, and `Status=RUNNING` until the scan finishes. The `Count` and `Index` are not updated until the scan is completed. When the scan is complete and the data is retrieved, `cbGetStatus()` and `GetStatus()` are updated to the current `Count` and `Index`, and `Status = IDLE`.

`BURSTIO` is the default mode for non-`CONTINUOUS` fast scans (aggregate sample rates above 1000 Hz) with sample counts up to 4096. `BURSTIO` mode allows higher sampling rates (up to 8000 Hz) for sample counts up to 4096. Non-`BURSTIO` scans are limited to a maximum of 1200 Hz. To avoid the `BURSTIO` default, specify `BLOCKIO` mode.

Continuous scans

When running `cbAInScan()` with the `CONTINUOUS` option, you should consider the packet size and the number of channels being scanned. In order to keep the data aligned properly in the array, make the total number of samples an integer multiple of the packet size and the number of channels.

Concurrent operations

Concurrent operations on a particular USB device are not allowed. If you invoke a UL or UL for .NET function on a USB device while another function is running on that USB device, the `ALREADYACTIVE` error is returned.

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the LED on a Measurement Computing USB device to blink.

When you have several USB devices connected to the computer, use these functions to identify a particular device by making its LED blink.

USB-1208 Series

The USB-1208LS and USB-1208FS support the following UL and UL for .NET features.

Analog input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbALoadQueue()`, `cbFileAInScan()`, `cbATrig()`

UL for .NET: `AIn()`, `AInScan()`, `ALoadQueue()`, `FileAInScan()`, `ATrig()`

Analog input argument values

Options

USB-1208LS

BACKGROUND, BLOCKIO*, BURSTIO**, CONTINUOUS, EXTTRIGGER, NOCALIBRATEDATA, and CONVERTDATA

USB-1208FS

BACKGROUND, BLOCKIO*, CONTINUOUS, EXTCLOCK, EXTTRIGGER, RETRIGMODE***, NOCALIBRATEDATA, and SINGLEIO

* USB-1208 Series packet size based on Options settings are as follows:

Device	Options setting	Packet size
USB-1208LS	BLOCKIO	64
USB-1208FS	BLOCKIO	31
	SINGLEIO	1

** BURSTIO can only be used with the number of samples (Count) set equal to the size of the FIFO or less. The USB-1208LS FIFO holds 4096 samples. BURSTIO cannot be used with the CONTINUOUS option.

*** RETRIGMODE can only be used with `cbAInScan()`/`AInScan()`.

HighChan

0 to 7 in single-ended mode

0 to 3 in differential mode

Count

In CONTINUOUS mode, Count *must* be an integer multiple of the packet size.

Rate

USB-1208LS

8000 Hz maximum for BURSTIO mode. The maximum rate is 1200 Hz for all other modes. When using `cbAInScan()` or `AInScan()`, the minimum sample rate is 100 Hz.

USB-1208FS

50 kHz maximum for BLOCKIO mode. The throughput is system dependant. Most systems will be able to achieve 40 kHz aggregate. Best results are obtained when using Windows XP or Windows Vista. When using `cbAInScan()` or `AInScan()`, the minimum sample rate is 1 Hz.

Range

Single-ended mode:

BIP10VOLTS (± 10 V)

Differential mode:

BIP20VOLTS	(± 20 V)	BIP2PT5VOLTS	(± 2.5 V)
BIP10VOLTS	(± 10 V)	BIP2VOLTS	(± 2 V)
BIP5VOLTS	(± 5 V)	BIP1PT25VOLTS	(± 1.25 V)
BIP4VOLTS	(± 4 V)	BIP1VOLTS	(± 1 V)

Pacing Hardware pacing, internal clock supported.
 External clock supported via the SYNC pin.

Triggering

Trigger functions and methods supported

UL: `cbSetTrigger()`
 UL for .NET: `SetTrigger()`

Trigger argument values

TrigType **USB-1208LS**
 TRIGHIGH and TRIGLOW
 USB-1208FS
 TRIGPOSEDGE and TRIGNEGEDGE
 Both products support external digital (TTL) hardware triggering. Use the `Trig_In` input for the external trigger signal.

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`
 UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options **USB-1208LS**
 Ignored
 USB-1208FS
 BACKGROUND, CONTINUOUS
 For the USB-1208FS, the number of samples (`Count`) in a CONTINUOUS scan needs to be an integer multiple of the packet size (32).

 HighChan 0 to 1

 Count **USB-1208LS**
 $(\text{HighChan} - \text{LowChan}) + 1$
 USB-1208FS
 `Count` must be an integer multiple of the number of channels in the scan. In a CONTINUOUS scan, `Count` must be an integer multiple of the packet size (32).

 Rate **USB-1208LS**
 Ignored
 USB-1208FS
 Up to 10 kHz maximum for a single channel
 Up to 5 kHz maximum for two channels
 Performance varies when operating on systems other than Windows XP or Windows Vista.

 Range **USB-1208LS**
 Ignored - Not programmable; fixed at `UNI5VOLTS` (0 to 5 V)

	USB-1208FS
	Ignored - Not programmable; fixed at UNI4VOLTS (0 to 4 V, nominal. Actual range is 0 to 4.096 V)
DataValue	USB-1208LS
	0 to 1023
	USB-1208FS
	0 to 4095

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigPort ()
UL for .NET:	DConfigPort ()
PortNum	FIRSTPORTA, FIRSTPORTB

Port I/O functions, methods, and argument values supported

UL:	cbDOut (), cbDIn ()
UL for .NET:	DOut (), DIn ()
PortNum	FIRSTPORTA, FIRSTPORTB
DataValue	0 to 255 for FIRSTPORTA or FIRSTPORTB

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn (), cbDBitOut ()
UL for .NET:	DBitIn (), DBitOut ()
PortType	FIRSTPORTA
BitNum	0 to 15 on FIRSTPORTA

Counter I/O

Counter I/O functions and methods supported

UL:	cbCIn () *, cbCIn32 (), cbCLoad () **, cbCLoad32 () **
UL for .NET:	CIn () *, CIn32 (), CLoad () **, CLoad32 () **

*Although cbCIn () and CIn () are valid for use with this counter, cbCIn32 () or CIn32 () may be more appropriate, since the values returned may be greater than the data types used by cbCIn () and CIn () can handle.

**cbCLoad (), cbCLoad32 (), CLoad () and CLoad32 () only accept Count=0. These functions are used to reset the counter.

Counter I/O argument values

CounterNum	1
Count	2 ³² -1 when reading the counter. 0 when loading the counter.

cbCLoad () and cbCLoad32 () / CLoad () and CLoad32 () are only used to reset the counter for this board to 0. No other values are valid.

The “[Basic signed integers](#)” guidelines on page 140 apply when using cbCIn () or CIn () for values greater than 32767, and when using cbCIn32 () or CIn32 () for values greater than 2147483647.

RegNum LOADREG1

Event notification

Even notification functions and methods supported

UL: cbEnableEvent(), cbDisableEvent()

UL for .NET: EnableEvent(), DisableEvent()

Event types: ON_SCAN_ERROR (analog input), ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN

The **USB-1208FS** also supports ON_END_OF_AO_SCAN and ON_SCAN_ERROR (analog output)

Hardware considerations

Acquisition Rate (USB-1208FS)

Since the maximum data acquisition rate depends on the system connected to the USB-1208FS, it is possible to "lose" data points when scanning at higher rates. The Universal Library cannot always detect this data loss. Maximum rates may be lower in Windows operating systems that predate Windows XP.

Most systems can sustain rates of 40 kS/s aggregate in BLOCKIO mode, and 1 kS/s aggregate in SINGLEIO mode.

BURSTIO (USB-1208LS)

BURSTIO mode allows higher sampling rates for sample counts up to the size of the FIFO. The USB-1208LS FIFO holds 4096 samples. Data is collected into the device's local FIFO. Data transfers to the PC don't occur until the scan completes. For BACKGROUND scans, the Count and Index returned by cbGetStatus() and GetStatus() remain 0, and Status=RUNNING until the scan finishes. The Count and Index are not updated until the scan is completed. When the scan is complete and the data is retrieved, cbGetStatus() and GetStatus() are updated to the current Count and Index, and Status = IDLE.

The USB-1208LS uses BURSTIO as the default mode for non-CONTINUOUS fast scans with sample counts up to the size of the FIFO (4096 samples). BURSTIO mode allows higher sampling rates for sample counts up to the size of the FIFO. Maximum Rate values of non-BURSTIO scans are limited (see Rate on page 87). To avoid the BURSTIO default, specify BLOCKIO mode.

EXTCLOCK (USB-1208FS)

By default, the **SYNC** pin is configured for pacer output and provides the internal pacer A/D clock signal. To configure the pin for pacer input, use the EXTCLOCK option.

If you use the EXTCLOCK option, make sure that you disconnect from the external clock source when you test or calibrate the device with *InstaCal*, as the **SYNC** pin drives the output.

RETRIGMODE (USB-1208FS)

When using cbAInScan()/AInScan(), you can use RETRIGMODE to set up repetitive trigger events.

Resolution

When configured for single-ended mode, the resolution of the data is 11 bits (data values between 0 and 2047). However, the Universal Library maps this data to 12-bit values, so the range of data is no different from the differential configuration. Consequently, the data returned contains only even numbers between 0 and 4094 when the NOCALIBRATEDATA option is used.

Continuous scans

When running `cbAInScan()` with the `CONTINUOUS` option, consider the packet size and the number of channels being scanned. To keep the data aligned properly in the array, make the total number of samples an integer multiple of the packet size and the number of channels in the scan.

Concurrent operations

USB-1208LS: Concurrent operations are not allowed. If you invoke a UL or UL for .NET function on a USB-1208LS while another function is running on that same unit, the `ALREADYACTIVE` error is returned.

USB-1208FS: The following table lists the concurrent operations supported by the USB-1208FS.

UL function/method	Can be run with...
<code>cbAOutScan()</code> / <code>AOutScan()</code> (BACKGROUND mode)	<ul style="list-style-type: none"> ▪ <code>cbDOut()</code> / <code>DOut()</code> ▪ <code>cbCLoad()</code> / <code>CLoad()</code> ▪ <code>cbCLoad32()</code> / <code>CLoad32()</code>
<code>cbAInScan()</code> / <code>AInScan()</code> (BACKGROUND mode)	<ul style="list-style-type: none"> ▪ <code>cbAOut()</code> / <code>AOut()</code> ▪ <code>cbDIn()</code> / <code>DIn()</code> ▪ <code>cbDBitIn()</code> / <code>DBitIn()</code> ▪ <code>cbDOut()</code> / <code>DOut()</code> ▪ <code>cbDBitOut()</code> / <code>DBitOut()</code> ▪ <code>cbDConfigPort()</code> / <code>DConfigPort()</code> ▪ <code>cbCIn()</code> / <code>CIn()</code> ▪ <code>cbCIn32()</code> / <code>CIn32()</code> ▪ <code>cbCLoad()</code> / <code>CLoad()</code> ▪ <code>cbCLoad32()</code> / <code>CLoad32()</code>

Channel-gain queue

USB-1208LS: When using `cbALoadQueue()` / `ALoadQueue()`, the channel gain queue is limited to eight elements.

USB-1208FS: When using `cbALoadQueue()` / `ALoadQueue()`, the channel gain queue is limited to 16 elements.

The queue accepts any combination of valid channels and gains in each element.

Analog output (USB-1208FS)

When you include both analog output channels in `cbAOutScan()` / `AOutScan()`, the two channels are updated simultaneously.

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the LED on a USB device to blink.

When you have several USB devices connected to the computer, use these functions to identify a particular device by making its LED blink.

USB-1408 Series

The USB-1408FS supports the following UL and UL for .NET features.

Analog input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbALoadQueue()`, `cbFileAInScan()`, `cbATrig()`

UL for .NET: `AIn()`, `AInScan()`, `ALoadQueue()`, `FileAInScan()`, `ATrig()`

Analog input argument values

Options BACKGROUND, BLOCKIO*, CONTINUOUS, EXTCLOCK, EXTTRIGGER, NOCALIBRATEDATA, RETRIGMODE**, and SINGLEIO

* USB-1408 Series packet size based on Options settings are as follows:

Device	Options setting	Packet size
USB-1408FS	BLOCKIO	31
	SINGLEIO	1

** RETRIGMODE can only be used with `cbAInScan()`/`AInScan()`.

HighChan 0 to 7 in single-ended mode

0 to 3 in differential mode

Count In CONTINUOUS mode, Count *must* be an integer multiple of the packet size.

Rate 48 kHz maximum for BLOCKIO mode. The throughput is system dependent. Most systems will be able to achieve 40 kHz aggregate. Best results are obtained when using Windows XP or Windows Vista. When using `cbAInScan()` or `AInScan()` the minimum sample rate is 1 Hz.

Range **Single-ended mode:**

BIP10VOLTS (± 10 V)

Differential mode:

BIP20VOLTS	(± 20 V)	BIP2PT5VOLTS	(± 2.5 V)
BIP10VOLTS	(± 10 V)	BIP2VOLTS	(± 2 V)
BIP5VOLTS	(± 5 V)	BIP1PT25VOLTS	(± 1.25 V)
BIP4VOLTS	(± 4 V)	BIP1VOLTS	(± 1 V)

Pacing Hardware pacing, internal clock supported.

External clock supported via the SYNC pin.

Triggering

Trigger functions and methods supported

UL: `cbSetTrigger()`

UL for .NET: `SetTrigger()`

Trigger argument values

TrigType TRIGPOSEDGE and TRIGNEGEDGE

External digital (TTL) hardware triggering supported. Use the `Trig_In` input for the external trigger signal.

Analog output

Analog output functions and methods supported

UL:	cbAOut (), cbAOutScan ()
UL for .NET:	AOut (), AOutScan ()

Analog output argument values

Options	BACKGROUND, CONTINUOUS For the USB-1408FS, the number of samples (Count) in a CONTINUOUS scan needs to be an integer multiple of the packet size (32).
HighChan	0 to 1
Count	The Count needs to be an integer multiple of the number of channels in the scan. In a CONTINUOUS scan, Count needs to be an integer multiple of the packet size (32).
Rate	Up to 10 kHz maximum for a single channel Up to 5 kHz maximum for two channels Performance varies when operating on systems other than Windows XP or Windows Vista.
Range	Ignored - Not programmable; fixed at UNI4VOLTS (0 to 4 V, nominal. Actual range is 0 to 4.096 V)
DataValue	0 to 4095

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigPort ()
UL for .NET:	DConfigPort ()
PortNum	FIRSTPORTA, FIRSTPORTB

Port I/O functions, methods, and argument values supported

UL:	cbDIn (), cbDOut ()
UL for .NET:	DIn (), DOut ()
PortNum	FIRSTPORTA, FIRSTPORTB
DataValue	0 to 255 for FIRSTPORTA or FIRSTPORTB

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn (), cbDBitOut ()
UL for .NET:	DBitIn (), DBitOut ()
PortType	FIRSTPORTA
BitNum	0 to 15 on FIRSTPORTA

Counter I/O

Counter I/O functions and methods supported

UL:	cbCIn () *, cbCIn32 (), cbCLoad () **, cbCLoad32 () **
UL for .NET:	CIn () *, CIn32 (), CLoad () **, CLoad32 () **

*Although `cbCIn()` and `CIn()` are valid for use with this counter, `cbCIn32()` or `CIn32()` may be more appropriate, since the values returned may be greater than the data types used by `cbCIn()` and `CIn()` can handle.

**`cbCLoad()`, `cbCLoad32()`, `CLoad()` and `CLoad32()` only accept `Count=0`. These functions are used to reset the counter.

Counter I/O argument values

CounterNum	1
Count	$2^{32}-1$ when reading the counter. 0 when loading the counter.

`cbCLoad()` and `cbCLoad32()` / `CLoad()` and `CLoad32()` are only used to reset the counter for this board to 0. No other values are valid.

The “[Basic signed integers](#)” guidelines on page 140 apply when using `cbCIn()` or `CIn()` for values greater than 32767, and when using `cbCIn32()` or `CIn32()` for values greater than 2147483647.

RegNum	LOADREG1
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Event notification

Event notification functions and methods supported

UL:	<code>cbEnableEvent()</code> , <code>cbDisableEvent()</code>
UL for .NET:	<code>EnableEvent()</code> , <code>DisableEvent()</code>
Event types:	<code>ON_SCAN_ERROR (analog input)</code> , <code>ON_DATA_AVAILABLE</code> , <code>ON_END_OF_AI_SCAN</code> , <code>ON_END_OF_AO_SCAN</code> and <code>ON_SCAN_ERROR (analog output)</code>

Hardware considerations

Acquisition Rate

Since the maximum data acquisition rate depends on the system connected to the USB-1408FS, it is possible to "lose" data points when scanning at higher rates. The Universal Library cannot always detect this data loss.

Maximum rates may be lower in Windows operating systems that predate Windows XP. Most systems can sustain rates of 40 kS/s aggregate in `BLOCKIO` mode, and 1 kS/s aggregate in `SINGLEIO` mode.

EXTCLOCK

By default, the SYNC pin is configured for pacer output and provides the internal pacer A/D clock signal. To configure the pin for pacer input, use the `EXTCLOCK` option.

If you use the `EXTCLOCK` option, make sure that you disconnect from the external clock source when you test or calibrate the device with *InstaCal*, as the SYNC pin drives the output.

RETRIGMODE

When using `cbAInScan()` / `AInScan()`, you can use `RETRIGMODE` to set up repetitive trigger events.

Resolution

When configured for single-ended mode, the resolution of the data is 13 bits (data values between 0 and 8191). However, the Universal Library maps this data to 14-bit values, so the range of data is no different from the differential configuration. Consequently, the data returned contains only even numbers between 0 and 16383 when the `NOCALIBRATEDATA` option is used.

Continuous scans

When running `cbAInScan()` with the `CONTINUOUS` option, consider the packet size and the number of channels being scanned. To keep the data aligned properly in the array, set the total number of samples to be an integer multiple of the packet size and the number of channels in the scan.

Concurrent operations

The following table lists the concurrent operations supported by the USB-1408FS.

UL function/method	Can be run with...
<code>cbAOutScan()</code> / <code>AOutScan()</code> (BACKGROUND mode)	<ul style="list-style-type: none"> ▪ <code>cbDOut()</code> / <code>DOut()</code> ▪ <code>cbCLoad()</code> / <code>CLoad()</code> ▪ <code>cbCLoad32()</code> / <code>CLoad32()</code>
<code>cbAInScan()</code> / <code>AInScan()</code> (BACKGROUND mode)	<ul style="list-style-type: none"> ▪ <code>cbAOut()</code> / <code>AOut()</code> ▪ <code>cbDIn()</code> / <code>DIn()</code> ▪ <code>cbDBitIn()</code> / <code>DBitIn()</code> ▪ <code>cbDOut()</code> / <code>DOut()</code> ▪ <code>cbDBitOut()</code> / <code>DBitOut()</code> ▪ <code>cbDConfigPort()</code> / <code>DConfigPort()</code> ▪ <code>cbCIn()</code> / <code>CIn()</code> ▪ <code>cbCIn32()</code> / <code>CIn32()</code> ▪ <code>cbCLoad()</code> / <code>CLoad()</code> ▪ <code>cbCLoad32()</code> / <code>CLoad32()</code>

Channel-gain queue

When using `cbALoadQueue()` / `ALoadQueue()`, the channel gain queue is limited to 16 elements. The queue accepts any combination of valid channels and gains in each element.

Analog output

When you include both analog output channels in `cbAOutScan()` / `AOutScan()`, the two channels are updated simultaneously.

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the LED on a USB device to blink.

When you have several USB devices connected to the computer, use these functions to identify a particular device by making its LED blink.

USB-1608FS

The USB-1608FS supports the following UL and UL for .NET features:

Analog input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbALoadQueue()`*, `cbFileAInScan()`, `cbATrig()`

UL for .NET: `AIn()`, `AInScan()`, `ALoadQueue()`*, `FileAInScan()`, `ATrig()`

* The channel-gain queue is limited to eight elements. The USB-1608FS accepts only unique contiguous channels in each element, but the gains may be any valid value.

Analog input argument values

Options BACKGROUND, BLOCKIO*, SINGLEIO*, BURSTIO**, CONTINUOUS, EXTTRIGGER, CONVERTDATA, NOCALIBRATEDATA, and EXTCLOCK

*The packet size is based on the Options setting as follows:

Options setting	Packet size
BLOCKIO	31
SINGLEIO	Equals the number of channels being sampled.

** BURSTIO can only be used with the number of samples (Count) set equal to the size of the FIFO or less. The USB-1608FS FIFO holds 32,768 samples. BURSTIO cannot be used with the CONTINUOUS option.

Mode Single-ended

HighChan 0 to 7 in single-ended mode

Count In BURSTIO mode, Count *must* be an integer multiple of the number of channels in the scan.

- For one-, two-, four-, and eight-channel scans, the maximum Count is 32768 samples.
- For three- and six-channel scans, the maximum Count is 32766 samples.
- For five-channel scans, the maximum Count is 32765 samples.
- For seven-channel scans, the maximum Count is 32767 samples.

Rate 200 kHz maximum for BURSTIO mode (50 kHz for any one channel). The maximum rate is 100 kHz for all other modes (50 kHz for any one channel). When using `cbAInScan()` or `AInScan()`, the minimum sample rate is 1 Hz. In BURSTIO mode, the minimum sample rate is 20 Hz/channel.

Range BIP10VOLTS (± 10 V) BIP2VOLTS (± 2 V)
BIP5VOLTS (± 5 V) BIP1VOLTS (± 1 V)

Pacing Hardware pacing, internal clock supported. External clock supported via the SYNC pin.

Triggering

Trigger functions and methods supported

UL: `cbSetTrigger()`

UL for .NET: `SetTrigger()`

Trigger argument values

TrigType Digital triggering: TRIGPOSEDGE, TRIGNEGEDGE. External digital (TTL) hardware triggering supported. Set the hardware trigger source with the Trig_In input.

Digital I/O**Configuration functions, methods, and argument values supported**

UL: cbDConfigBit(), cbDConfigPort()
 UL for .NET: DConfigBit(), DConfigPort()
 PortNum AUXPORT
 PortType AUXPORT

Port I/O functions, methods, and argument values supported

UL: cbDOut(), cbDIn()
 UL for .NET: DOut(), DIn()
 PortNum AUXPORT (eight bits, bit-configurable)
 DataValue 0 to 255 for AUXPORT

Bit I/O functions, methods, and argument values supported

UL: cbDBitIn(), cbDBitOut()
 UL for .NET: DBitIn(), DBitOut()
 PortType AUXPORT
 BitNum 0 to 7 on AUXPORT

Counter I/O**Counter I/O functions and methods supported**

UL: cbCIn(), cbCIn32(), cbCLoad(), cbCLoad32()
 UL for .NET: CIn(), CIn32(), CLoad(), CLoad32()

*Although cbCIn() and CIn() are valid for use with this counter, cbCIn32() or CIn32() may be more appropriate, since the values returned may be greater than the data types used by cbCIn() and CIn() can handle.

**cbCLoad(), cbCLoad32(), CLoad() and CLoad32() only accept Count=0. These functions are used to reset the counter.

Counter I/O argument values

CounterNum 1
 Count $2^{32}-1$ when reading the counter.
 LoadValue 0 when loading the counter.

cbCLoad() and cbCLoad32() / CLoad() and CLoad32() are only used to reset the counter for this board to 0. No other values are valid.

The “[Basic signed integers](#)” guidelines on page 140 apply when using cbCIn() or CIn() for values greater than 32767, and when using cbCIn32() or CIn32() for values greater than 2147483647.

RegNum LOADREG1

Event notification

Even notification functions and methods supported

UL:	<code>cbEnableEvent()</code> , <code>cbDisableEvent()</code>
UL for .NET:	<code>EnableEvent()</code> , <code>DisableEvent()</code>
Event types:	<code>ON_SCAN_ERROR</code> , <code>ON_DATA_AVAILABLE</code> , <code>ON_END_OF_AI_SCAN</code>

Hardware considerations

Acquisition rate

Since the maximum data acquisition rate depends on the system connected to the device, it is possible to "lose" data points when scanning at higher rates. If the requested speed cannot be sustained, an `OVERRUN` error will occur.

Maximum rates may be lower in Windows operating systems that predate Windows XP.

Continuous scans

When running `cbAInScan()` with the `CONTINUOUS` option, you should consider the packet size and the number of channels being scanned. In order to keep the data aligned properly in the array, make the total number of samples an integer multiple of the packet size and the number of channels.

EXTCLOCK

You can set the **SYNC** pin on the USB-1608FS as a pacer input or a pacer output from *InstaCal*. By default, this pin is set for pacer input. If set for output when using the `cbAInScan()/AInScan()` option, `EXTCLOCK` results in a `BADOPTION` error.

BURSTIO

`BURSTIO` mode allows higher sampling rates for sample counts up to the size of the FIFO. The USB-1608FS device's FIFO holds 32,768 samples. Data is collected into the device's local FIFO. Data transfers to the PC don't occur until the scan completes. For `BACKGROUND` scans, the `Count` and `Index` returned by `cbGetStatus()` and `GetStatus()` remain 0, and `Status=RUNNING` until the scan finishes. The `Count` and `Index` are not updated until the scan is completed. When the scan is complete and the data is retrieved, `cbGetStatus()` and `GetStatus()` are updated to the current `Count` and `Index`, and `Status = IDLE`.

`BURSTIO` is required for aggregate `Rate` settings above 100 kHz, but `Count` is limited to sample counts up to the size of the FIFO (32,768 samples). `Count` settings must be an integer multiple of the number of channels in the scan.

Miscellaneous functions and methods supported

UL:	<code>cbFlashLED()</code>
UL for .NET:	<code>FlashLED()</code>

Causes the LED on a USB device to blink. When you have several USB devices connected to the computer, use these functions to identify a particular device by making its LED blink.

USB-1608HS, USB-1608HS-2AO

The USB-1608HS and USB-1608HS-2AO support the following UL and UL for .NET features:

Analog input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbFileAInScan()`, `cbATrig()`, `cbALoadQueue()` *

UL for .NET: `AIn()`, `AInScan()`, `FileAInScan()`, `ATrig()`, `ALoadQueue()` *

* The channel-gain queue is limited to eight elements. The USB-1608HS series accepts only unique contiguous channels in each element, but the gains may be any valid value.

Analog input argument values

Options BACKGROUND, BLOCKIO*, SINGLEIO*, CONTINUOUS, EXTTRIGGER, CONVERTDATA, NOCALIBRATEDATA, RETRIGMODE, and EXTCLOCK

* The packet size is rate-dependent. The following table lists the aggregate rates and packet sizes when using `cbAInScan()`/`AInScan()` with devices connected to a high-speed USB 2.0 port:

Options setting	Aggregate rate	Packet size
BLOCKIO	<100 kHz	256 samples
	100 kHz to 200 kHz	512 samples
	200 kHz to 500 kHz	1024 samples
	500 kHz to 1 MHz	2048 samples
	> 1 MHz	4096 samples
SINGLEIO		Equals the number of channels being sampled.

Mode Single-ended and differential

HighChan 0 to 7 in single-ended and differential mode

Rate 250 kHz per channel

Range BIP10VOLTS (± 10 V) BIP2VOLTS (± 2 V)

BIP5VOLTS (± 5 V) BIP1VOLTS (± 1 V)

Pacing Hardware pacing, internal clock supported.

External clock supported via the SYNC_IN pin.

Analog output (USB-1608HS-2AO only)

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options BACKGROUND, CONTINUOUS

NONSTREAMEDIO can only be used with the number of samples set equal to the size of the FIFO or less. The FIFO holds 524288 samples.

HighChan 0 to 1

Rate 70 kHz for one channel

	47 kHz for two channels
Range	BIP10VOLTS (± 10 volts)
Packet size	512 samples
DataValue	0 to 65535 (Refer to "16-bit values using a signed integer data type" on page 16 for information on 16-bit values using unsigned integers).
Pacing	Hardware pacing, internal clock supported.

Triggering

Trigger functions and methods supported

UL:	<code>cbSetTrigger()</code>
UL for .NET:	<code>SetTrigger()</code>

Trigger argument values

TrigType	Analog triggering: TRIGABOVE, TRIGBELOW. Digital triggering: TRIGPOSEDGE, TRIGNEGEDGE, TRIGHIGH, TRIGLOW. External digital (TTL) hardware triggering supported. Set the hardware trigger source with the <code>Trig_In</code> input.
Threshold	0 to 65535 (BIP10VOLTS) (Hardware actually has 12 bit resolution, but the library uses a 16 bit value so that <code>cbFromEngUnits()</code> can be used to obtain the trigger value.)

Digital I/O

Configuration functions, methods, and argument values supported

UL:	<code>cbDConfigPort()</code>
UL for .NET:	<code>DConfigPort()</code>
PortNum	AUXPORT
PortType	AUXPORT

Port I/O functions, methods, and argument values supported

UL:	<code>cbDOut()</code> , <code>cbDIn()</code>
UL for .NET:	<code>DOut()</code> , <code>DIn()</code>
PortNum	AUXPORT
DataValue	0 to 255 for AUXPORT

Bit I/O functions, methods, and argument values supported

UL:	<code>cbDBitIn()</code> , <code>cbDBitOut()</code>
UL for .NET:	<code>DBitIn()</code> , <code>DBitOut()</code>
PortType	AUXPORT
BitNum	0 to 7 on AUXPORT

Counter I/O

Counter I/O functions and methods supported

UL:	<code>cbCIn()</code> *, <code>cbCIn32()</code> , <code>cbCLoad()</code> **, <code>cbCLoad32()</code> **
UL for .NET:	<code>CIn()</code> *, <code>CIn32()</code> , <code>CLoad()</code> **, <code>CLoad32()</code> **

*Although `cbCIn()` and `CIn()` are valid for use with this counter, `cbCIn32()` or `CIn32()` may be more appropriate, since the values returned may be greater than the data types used by `cbCIn()` and `CIn()` can handle.

**`cbCLoad()`, `cbCLoad32()`, `CLoad()` and `CLoad32()` only accept `Count=0`. These functions are used to reset the counter.

Counter I/O argument values

CounterNum	1
Count	$2^{32}-1$ when reading the counter.
LoadValue	0 when loading the counter.

`cbCLoad()` and `cbCLoad32()` / `CLoad()` and `CLoad32()` are only used to reset the counter for this board to 0. No other values are valid.

The “[Basic signed integers](#)” guidelines on page 140 apply when using `cbCIn()` or `CIn()` for values greater than 32767, and when using `cbCIn32()` or `CIn32()` for values greater than 2147483647.

RegNum	LOADREG1
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Configuration

Configuration functions and methods supported

UL:	<code>cbGetConfig()</code> , <code>cbSetConfig()</code> , <code>cbGetConfigString()</code> , <code>cbSetConfigString()</code>
ConfigItem:	<code>BIADTRIGCOUNT</code> , <code>BINODEID</code>
Device Number:	0
maxConfigLen:	At least 64 for <code>BINODEID</code>

Event notification

Even notification functions and methods supported

UL:	<code>cbEnableEvent()</code> , <code>cbDisableEvent()</code>
UL for .NET:	<code>EnableEvent()</code> , <code>DisableEvent()</code>
Event types:	<code>ON_SCAN_ERROR</code> , <code>ON_DATA_AVAILABLE</code> , <code>ON_END_OF_AI_SCAN</code>

Hardware considerations

Acquisition rate

Since the maximum data acquisition rate depends on the system connected to the device, it is possible to "lose" data points when scanning at higher rates. If the requested speed cannot be sustained, an `OVERRUN` error will occur.

Maximum rates may be lower in Windows operating systems that predate Windows XP.

Continuous scans

When running `cbAIInScan()` with the `CONTINUOUS` option, you should consider the packet size and the number of channels being scanned. In order to keep the data aligned properly in the array, make the total number of samples an integer multiple of the packet size and the number of channels.

Device identifier

You can enter up to 64 characters for the value of the device's text identifier using the `ConfigItem` option `BINODEID` with `cbSetConfigString()`.

Output scan restriction

You cannot access `cbSetTrigger()/SetTrigger()` or call `BINODEID` while an analog output scan is in progress.

Analog triggering

When using `cbAInScan()/AInScan()` with `EXTTRIGGER`, the value entered to `cbSetTrigger()` threshold arguments for analog trigger modes should be a 16 bit value. The resolution of the circuitry is actually 12 bits, but the library uses a 16 bit value so that `cbFromEngUnits()` can be used to obtain the trigger value.

Retriggering

When using `cbAInScan()/AInScan()`, you can use `RETRIGMODE` to set up repetitive trigger events. When using `RETRIGMODE`, it is best to set the values for the Count argument (`cbAInScan()/AInScan()`) and the `BIADTRIGCOUNT` argument (`cbSetConfig()/SetAdRetrigCount()`) to an integer multiple of the packet size (and the number of channels if using `CONTINUOUS`). That way, the entire buffer, or the portion of the buffer defined by `BIADTRIGCOUNT`, will contain updated data.

Remote sensing (USB-1608HS-2AO)

You can enable remote sensing for each of the two analog outputs on the USB-1608HS-2AO with *InstaCal*. The remote sensing feature compensates for the voltage drop error that occurs in applications where the USB-1608HS-2AO's analog outputs are connected to its load through a long wire or cable type interconnect.

The remote sensing feature can compensate for $I \cdot R$ induced voltage losses up to 750 mV, and for any series resistance up to 75 Ω between its remote sensing terminal pins and its output load.

- To configure the remote sensing connection, connect two separate output wires — one from the `VDACn_F` (force) output terminal, and one from the `VDACn_S` (sense) output terminal — to the high side or positive input terminal of the field device (load).
- If you are not using the remote sensing feature, simply connect a single output wire or cable from the `VDACn_F` (force) output terminal to the load, and leave the `VDACn_S` (sense) terminal unconnected.

Refer to the *USB-1608HS-2AO User's Guide* for more information about remote sensing.

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the LED on a USB device to blink. When you have several USB devices connected to the computer, use these functions to identify a particular device by making its LED blink.

USB-1616FS

The USB-1616FS supports the following UL and UL for .NET features.

Analog input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbALoadQueue()`*, `cbFileAInScan()`, `cbATrig()`

UL for .NET: `AIn()`, `AInScan()`, `ALoadQueue()`*, `FileAInScan()`, `ATrig()`

*The channel-gain queue is limited to 16 elements. The USB-1616FS accepts only unique contiguous channels in each element, but the gains may be any valid value.

Analog input argument values

Options: BACKGROUND, BLOCKIO**, BURSTIO***, CONTINUOUS, EXTTRIGGER, SINGLEIO**, and EXTCLOCK

**USB-1616 Series packet size based on Options settings

Device	Options setting	Packet size
USB-1616FS	BLOCKIO	62
	SINGLEIO	Equals the number of channels being sampled.

*** BURSTIO can only be used with the number of samples (Count) set equal to the size of the FIFO or less. The USB-1616FS FIFO holds 32,768 samples. Also, BURSTIO cannot be used with the CONTINUOUS option.

HighChan 0 to 15 in single-ended mode

Count In BURSTIO mode, Count needs to be an integer multiple of the number of channels in the scan.

- For one-, two-, four-, eight-, and 16-channel scans, the maximum Count is 32768 samples.
- For three- and six-channel scans, the maximum Count is 32766 samples
- For five-channel scans, the maximum Count is 32765 samples
- For seven-channel scans, the maximum Count is 32767 samples
- For 9-, 10-, 12-, 13-, 14-, and 15-channel scans, the maximum Count is 32760 samples
- For 11-channel scans, the maximum Count is 32758 samples.

Rate: 200 kilohertz (kHz) maximum for BURSTIO mode (50 kHz for any one channel). For all other modes, the maximum rate per channel depends on the number of channels being scanned.

No. of channels in the scan	Maximum rate
1 or 2	50 kHz
3	36 kHz
4	30 kHz
5	25 kHz
6	22 kHz
7	19 kHz
8	17 kHz
9	15 kHz

No. of channels in the scan	Maximum rate
10	14 kHz
11	12.5 kHz
12	12 kHz
13	11.25 kHz
14	10.5 kHz
15	10 kHz
16	9.5 kHz

When using `cbAInScan()` or `AInScan()`, the minimum sample rate is 1 Hz. In BURSTIO mode, the minimum sample rate is 20 Hz/channel.

Range:	Single-ended:
	BIP10VOLTS (± 10 volts)
	BIP2VOLTS (± 2 volts)
	BIP5VOLTS (± 5 volts)
	BIP1VOLTS (± 1 volt)
Pacing:	Hardware pacing, internal clock supported.
	External clock supported via the SYNC pin.

Triggering

Triggering functions and methods supported

UL:	cbSetTrigger()
UL for .NET:	SetTrigger()

Trigger argument values

TrigType:	TRIGPOSEDGE, TRIGNEGEDGE
	External digital (TTL) hardware triggering supported. You set the hardware trigger source with the TRIG_IN input terminal.

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigBit(), cbDConfigPort()
UL for .NET:	DConfigBit(), DConfigPort()
PortNum	AUXPORT
PortType	AUXPORT

Port I/O functions, methods, and argument values supported

UL:	cbDOut(), cbDIn()
UL for .NET:	DOut(), DIn()
PortNum	AUXPORT
DataValue	0 to 255 for AUXPORT

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn(), cbDBitOut()
UL for .NET:	DBitIn(), DBitOut()
PortType	AUXPORT
BitNum	0 to 7 on AUXPORT

Counter I/O

Counter I/O functions and methods supported

UL:	cbCIn(), cbCIn32(), cbCLoad(), cbCLoad32(), **
UL for .NET:	CIn(), CIn32(), CLoad(), CLoad32(), ** *

Although `cbCIn()` and `CIn()` are valid for use with this counter, `cbCIn32()` or `CIn32()` may be more appropriate, since the values returned may be greater than the data types used by `cbCIn()` and `CIn()` can handle. `**cbCLoad()`, `cbCLoad32()`, `CLoad()` and `CLoad32()` only accept `Count=0`. These functions are used to reset the counter.

Counter I/O argument values

CounterNum:	1
Count	2 ³² -1 when reading the counter. 0 when loading the counter.
	cbCLoad() and cbCLoad32() / CLoad() and CLoad32() are only used to reset the counter for this board to 0. No other values are valid.

The “[Basic signed integers](#)” guidelines on page 140 apply when using cbCIn() or CIn() for values greater than 32767, and when using cbCIn32() or CIn32() for values greater than 2147483647.

Event notification**Even notification functions and methods supported**

UL:	cbEnableEvent(), cbDisableEvent()
UL for .NET:	EnableEvent(), DisableEvent()
Event types:	ON_SCAN_ERROR, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN

Hardware considerations**Acquisition rate**

Since the maximum data acquisition rate depends on the system connected to the USB-1616FS, it is possible to "lose" data points when scanning at higher rates. The Universal Library cannot always detect this data loss. Maximum rates may be lower in Windows operating systems that predate Windows XP. Most systems can sustain rates of 80 kS/s aggregate. If you need to sample at higher rates than this, consider using the BURSTIO option explained later in this topic.

EXTCLOCK

You can set the SYNC pin as a pacer input or a pacer output from *InstaCal*. By default, this pin is set for pacer input. If set for output, using the cbAInScan()/AInScan() option EXTCLOCK results in a BADOPTION error.

BURSTIO

Allows higher sampling rates up to the size of the FIFO. The USB-1616FS FIFO holds 32,768 samples. Data is collected into the USB device's local FIFO. Data transfers to the PC don't occur until the scan completes. For BACKGROUND scans, the Count and Index returned by cbGetStatus() and GetStatus() remain 0, and STATUS=RUNNING until the scan finishes. The Count and Index are not updated until the scan is completed. When the scan is complete and the data is retrieved, cbGetStatus() and GetStatus() are updated to the current Count and Index, and STATUS=IDLE.

BURSTIO is required for aggregate Rate settings above 100 kHz, but Count is limited to sample counts up to the size of the FIFO (32,768 samples). Count settings must be an integer multiple of the number of channels in the scan (see Count above).

Continuous scans

When running cbAInScan()/AInScan() with the CONTINUOUS option, you should consider the packet size and the number of channels being scanned. In order to keep the data aligned properly in the array, make the total number of samples an integer multiple of the packet size and the number of channels.

When running cbAInScan()/AInScan() with the CONTINUOUS option, you must set the count to an integer multiple of the packet size (62) and the number of channels in the scan.

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the USB LED on a Measurement Computing USB module to blink.

When you have several modules connected to the computer, use these functions to identify a particular module by making its LED blink.

USB-1616HS, USB-1616HS-2, and USB-1616HS-4

The USB-1616HS Series includes the USB-1616HS, USB-1616HS-2, and USB-1616HS-4.

Analog input

Analog input functions and methods supported

UL:	<code>cbAIn()</code> , <code>cbAInScan()</code> , <code>cbALoadQueue()</code> , <code>cbFileAInScan()</code> , <code>cbATrig()</code> , <code>cbAPretrig()</code> *
UL for .NET:	<code>AIn()</code> , <code>AInScan()</code> , <code>ALoadQueue()</code> , <code>FileAInScan()</code> , <code>ATrig</code> , <code>APretrig()</code> *
	* Pretrigger capability is implemented in software. <code>PretrigCount</code> must be less than the <code>TotalCount</code> and cannot exceed 100000 samples. <code>TotalCount</code> must be greater than the <code>PretrigCount</code> . If a trigger occurs while the number of collected samples is less than the <code>PretrigCount</code> , that trigger will be ignored. Requires a call to <code>cbSetTrigger/SetTrigger</code> for the analog trigger type.

Analog input argument values

Options	<code>BACKGROUND</code> , <code>CONTINUOUS</code> , <code>EXTCLOCK</code> , <code>CONVERTDATA</code> , <code>DMAIO</code> , <code>BLOCKIO</code> , <code>EXTTRIGGER</code> *	
	* With <code>EXTTRIGGER</code> mode, the first channel in the scan is the analog trigger channel.	
HighChan	0 to 15 in single-ended mode, 0 to 7 in differential mode. (0 to 63 single-ended, 0 to 31 differential if the AI-EXP48 expansion board is installed.)	
Rate	Up to 1 MHz	
Range	<code>BIP10VOLTS</code>	(± 10 V)
	<code>BIP5VOLTS</code>	(± 5 V)
	<code>BIP2VOLTS</code>	(± 2 V)
	<code>BIP1VOLTS</code>	(± 1 V)
	<code>BIPPT5VOLTS</code>	(± 0.5 V)
	<code>BIPPT2VOLTS</code>	(± 0.2 V)
	<code>BIPPT1VOLTS</code>	(± 0.1 V)

Analog output (USB-1616HS-2 and USB-1616HS-4 only)

Analog output functions and methods supported

UL:	<code>cbAOut()</code> , <code>cbAOutScan()</code>
UL for .NET:	<code>AOut()</code> , <code>AOutScan()</code>

Analog output argument values

Options	<code>BACKGROUND</code> , <code>CONTINUOUS</code> , <code>EXTCLOCK</code> , <code>SIMULTANEOUS</code> , <code>NONSTREAMEDIO</code> , <code>ADCCLOCKTRIG</code> , <code>ADCCLOCK</code>	
	<code>NONSTREAMEDIO</code> can only be used with the number of samples set equal to the size of the FIFO or less. The FIFO holds 524288 samples.	
HighChan	USB-1616HS-4: 0 to 3 USB-1616HS-2: 0 to 1	
Rate	1 MHz	
Range	Ignored - Not programmable; fixed at <code>BIP10VOLTS</code> (± 10 volts)	
DataValue	0 to 65535 (Refer to "16-bit values using a signed integer data type" on page 16 for information on 16-bit values using unsigned integers).	
Pacing	Hardware pacing, external or internal clock supported.	

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigPort()
UL for .NET:	DConfigPort()
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTC

Port I/O functions, methods, and argument values supported

UL:	cbDIn(), cbDOut(), cbDInScan(), cbDOutScan() *
UL for .NET:	DIn(), DOut(), DInScan(), DOutScan() *
	*FIRSTPORTA and FIRSTPORTB must be set for output to use this function. Refer to "DIO PortNum" on page 113 for more information.
Options	BACKGROUND, CONTINUOUS, EXTCLOCK, EXTTRIGGER, WORDXFER, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK The EXTTRIGGER option can only be used with cbDInScan()/DInScan(). You can use cbSetTrigger()/SetTrigger() to program the trigger for rising edge, falling edge, or the level of the digital trigger input (TTL). The WORDXFER option can only be used with FIRSTPORTA. The NONSTREAMEDIO, ADCCLOCKTRIG, and ADCCLOCK options can only be used with cbDOutScan()/DOutScan(). The NONSTREAMEDIO option can only be used with the number of samples set equal to the size of the FIFO or less. The FIFO holds 524288 samples.
Rate	12 MHz
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTC
DataValue	0 to 255 0 to 65535 using the WORDXFER option with FIRSTPORTA

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn(), cbDBitOut()
UL for .NET:	DBitIn(), DBitOut()
PortType	FIRSTPORTA
BitNum	0 to 23

Counter input

Counter functions and methods supported

UL:	cbCIn(), cbCIn32(), cbCConfigScan(), cbCInScan(), cbCClear()
UL for .NET:	CIn(), CIn32(), CConfigScan(), CInScan(), CClear()

Note: Counters on these devices are zero-based (the first counter number is "0").

Counter argument values

Rate	6 MHz
CounterNum	0 to 3
Options	BACKGROUND, CONTINUOUS, EXTTRIGGER

You can use `cbSetTrigger()/SetTrigger()` to program the trigger for rising edge, falling edge, or the level of the digital trigger input (TTL).

LoadValue

0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers.)

Timer output

Timer functions and methods supported

UL: `cbTimerOutStart()`, `cbTimerOutStop()`

UL for .NET: `TimerOutStart()`, `TimerOutStop()`

Timer argument values

TimerNum 0 to 1

Frequency 15.260 Hz to 1.0 MHz

Triggering

Trigger functions and methods supported

UL: `cbSetTrigger()`

UL for .NET: `SetTrigger()`

Trigger argument values

TrigType TRIGABOVE, TRIGBELOW, TRIGHIGH, TRIGLOW, TRIGPOSEDGE, TRIGNEGEDGE

Digital triggering (TRIGHIGH, TRIGLOW, TRIGPOSEDGE, TRIGNEGEDGE) is not supported for pre-trigger acquisitions (`cbAPretrig()/APretrig()`). Analog triggering (TRIGABOVE, TRIGBELOW) is not supported for `cbDInScan()/DInScan()` and `cbCInScan()/CInScan()`.

Threshold Analog hardware triggering, 12-bit resolution:
0 to 4095 (supported for `cbAInScan()/AInScan()` only)

Analog software triggering, 16-bit resolution:
0 to 65535 (supported for `cbAPretrig()/APretrig()` only)

Temperature input

Temperature input functions and methods supported

UL: `cbTIn()`, `cbTInScan()`, `cbGetTCValues()`

UL for .NET: `TIn()`, `TInScan()`, `GetTCValues()`

Temperature input argument values

Options NOFILTER

Scale CELSIUS, FAHRENHEIT, KELVIN

HighChan 0 to 7 (0 to 31 if the AI-EXP48 expansion board is installed.)

DAQ input

DAQ input functions and methods supported

UL: `cbDaqInScan()`

UL for .NET: `DaqInScan()`

DAQ input argument values

Options BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, DMAIO, BLOCKIO, EXTTRIGGER

ChanTypeArray	ANALOG, DIGITAL8, DIGITAL16, CTR16, CTR32LOW, CTR32HIGH, CJC, TC, SETPOINTSTATUS	
	Note: for information on associating CJC channels with TC channels, refer to "Hardware considerations" on page 112.	
ChanArray	ANALOG:	0 to 15 in single-ended mode, 0 to 7 in differential mode (0 to 63 single-ended, 0 to 31 differential if the AI-EXP48 expansion board is installed.)
	DIGITAL8:	FIRSTPORTA, FIRSTPORTB, FIRSTPORTC
	DIGITAL16:	FIRSTPORTA
	CTR16:	0-3 counters
	CTR32LOW:	0-3 counters
	CTR32HIGH:	0-3 counters
	CJC:	0 to 5 (0 to 11 if the AI-EXP48 expansion board is installed.)
	TC:	0 to 7 (0 to 31 if the AI-EXP48 expansion board is installed.)
	SETPOINTSTATUS: 16-bit port that indicates the current state of the 16 possible setpoints.	
	ChanTypeArray flag value:	
	SETPOINT_ENABLE: Enables a setpoint. Refer to "Hardware considerations" on page 112 for more information.	
Rate	Analog:	Up to 1 MHz
	Digital:	Up to 12 MHz if no analog channel is selected. Otherwise up to 1 MHz.
	Counter:	Up to 12 MHz if no analog channel is selected. Otherwise up to 1 MHz.
GainArray	ANALOG only; ignore for other ChanTypeArray values.	
	BIP10VOLTS	(± 10 V)
	BIP5VOLTS	(± 5 V)
	BIP2VOLTS	(± 2 V)
	BIP1VOLTS	(± 1 V)
	BIPPT5VOLTS	(± 0.5 V)
	BIPPT2VOLTS	(± 0.2 V)
	BIPPT1VOLT	(± 0.1 V)
PreTrigCount	100000 max	

DAQ triggering

DAQ trigger functions and methods supported

UL:	cbDaqSetTrigger()
UL for .NET:	DaqSetTrigger()

DAQ trigger argument values

TrigSource	TRIG_IMMEDIATE, TRIG_EXTTTL, TRIG_ANALOGHW, TRIG_ANALOGSW, TRIG_DIGPATTERN, TRIG_COUNTER, TRIG_SCANCOUNT
TrigSense	RISING_EDGE, FALLING_EDGE, ABOVE_LEVEL, BELOW_LEVEL, EQ_LEVEL, NE_LEVEL

TrigEvent START_EVENT, STOP_EVENT

DAQ setpoint

DAQ setpoint functions and methods supported

UL: cbDaqSetSetpoints()

UL for .NET: DaqSetSetpoints()

DAQ setpoint argument values

SetpointFlagsArray SF_EQUAL_LIMITA, SF_LESSTHAN_LIMITA, SF_GREATERTHAN_LIMITB,
SF_OUTSIDE_LIMITS, SF_HYSTERESIS, SF_UPDATEON_TRUEONLY,
SF_UPDATEON_TRUEANDFALSE

SetpointOutputArray SO_NONE, SO_FIRSTPORTC, SO_TMR0, SO_TMR1

also available for USB-1616HS-2:

SO_DAC0, SO_DAC1

also available for USB-1616HS-4:

SO_DAC0, SO_DAC1, SO_DAC2, SO_DAC3

LimitAArray Any value valid for the associated input channel
Ignored for SF_GREATERTHAN_LIMITB

LimitBArray Any value valid for the associated input channel and less than LimitA
Ignored for SF_EQUAL_LIMITA, SF_LESSTHAN_LIMITA

Output#Array For SetpointOutputArray = SO_NONE:
Ignored

For SetpointOutputArray = SO_FIRSTPORTC:
0 to 65535

For SetpointOutputArray = SO_TMR#:
0 (to disable timer) or 15.26 to 1000000 (to set output frequency)

For SetpointOutputArray = SO_DAC#:
Voltage values between -10 and +10

OutputMask#Array For SetpointOutputArray = SO_FIRSTPORTC:
0 to 65535

For SetpointOutputArray = all other values:
Ignored

SetpointCount 0 (to disable setpoints) to 16

DAQ output (USB-1616HS-2 and USB-1616HS-4 only)

DAQ output functions and methods supported

UL: cbDaqOutScan()

UL for .NET: DaqOutScan()

DAQ output argument values

Options BACKGROUND, CONTINUOUS, EXTCLOCK, SIMULTANEOUS, NONSTREAMEDIO,
ADCCLOCKTRIG, ADCCLOCK

ChanType ANALOG, DIGITAL16

ChanArray	ANALOG:	USB-1616HS-4: 0 to 3 USB-1616HS-2: 0 to 1
	DIGITAL16:	FIRSTPORTA (FIRSTPORTB must be configured as an output)
Rate	ANALOG:	Up to 1 MHz
	DIGITAL16:	Up to 12 MHz (system-dependent) if no analog channel is selected. Otherwise up to 1 MHz.
Range	BIP10VOLTS	(± 10 V)

Hardware considerations

Associating CJC channels with TC channels

The TC channels must immediately follow their associated CJC channels in the channel array. For accurate thermocouple readings, associate CJC channels with the TC channels as listed in the following table:

CJC channels	TC channels
CJC0	TC0
CJC1	TC1 and TC2
CJC2	TC3
CJC3	TC4
CJC4	TC5 and TC6
CJC5	TC7
When the AI-EXP48 board is installed:	
CJC6	TC8 through TC11
CJC7	TC12 through TC15
CJC8	TC16 through TC19
CJC9	TC20 through TC23
CJC10	TC24 through TC27
CJC11	TC28 through TC31

The board must be configured for differential inputs when using thermocouples

TC inputs are supported by differential mode configuration only.

Channel count

For input and output scans, the count must be set to an integer multiple of the number of channels or a BADCOUNT error is returned.

Sampling and update rates

Sampling and update rates are system-dependent. Data overruns/underruns may occur with higher sampling rates when using BACKGROUND and CONTINUOUS modes. To avoid this, use a larger buffer/count size, or use NONSTREAMEDIO mode, if supported. The minimum size buffer is 256 for cbAOutScan() / AOutScan(). Values less than that result in a BADBUFFERSIZE error.

Settling time

For most applications, settling time should be left at the default value of 1 μ s. However, if you are scanning multiple channels and one or more channels are connected to a high impedance source, you may get better results by increasing the settling time. Keep in mind that increasing the settling time reduces the maximum acquisition rate. You can set the time between A/D conversions with the ADC Settling Time option in InstaCal. Select between 1 μ s, 5 μ s, 10 μ s, or 1 ms.

Setpoints

You enable setpoints with the `SETPOINT_ENABLE` flag. This flag must be OR'ed with the `ChanTypeArray` argument values. You set the setpoint criteria with `cbDagSetSetpoints()/DagSetSetpoints()`. The number of channels set with the `SETPOINT_ENABLE` flag must match the number of setpoints set by the `SetpointCount` argument (`cbDagSetSetpoints()/DagSetSetpoints()`).

Output non-streamed data to a DAC output channel

With `NONSTREAMEDIO` mode, you can output non-streamed data to a specific DAC output channel. The aggregate size of the data output buffer must be less than or equal to the size of the internal data output FIFO in the device. The FIFO holds 524288 samples. This allows the data output buffer to be loaded into the device's internal output FIFO. Once the sample updates are transferred or downloaded to the device, the device is responsible for outputting the data. You can't change the output buffer once the output begins.

Trigger DAC output operations with the ADC clock

Specify the `ADCCLOCKTRIG` option to trigger a data output operation upon the start of the ADC clock.

DIO PortNum

For `cbDOutScan()/DOutScan()` and `cbDagOutScan()/DagOutScan()`, `FIRSTPORTA` and `FIRSTPORTB` are treated as one 16-bit port. These functions can only be used with `FIRSTPORTA`. You must configure both `FIRSTPORTA` and `FIRSTPORTB` for output using `cbDConfigPort()/DConfigPort()`.

Synchronous scanning with multiple boards

You can operate up to four USB-1616HS Series boards synchronously by setting the direction of the A/D and D/A pacer pins (**APR** or **DPR**) in *InstaCal*.

On the board used to pace each device, set the pacer pin that you want to use (**APR** or **DPR**) for *Output*. On the board(s) that you want to synchronize with this board, set the pacer pin that you want to use (**APR** or **DPR**) for *Input*.

You set the direction using the *InstaCal* configuration dialog's **APR Pin Direction** and **DPR Pin Direction** settings

Wire the pacer pin configured for output to each of the pacer input pins that you want to synchronize.

Quadrature encoder operations

To configure a counter channel as a multi-axis quadrature encoder, use the `cbCConfigScan()/CConfigScan()` Mode argument values to set a specified counter to encoder mode, set the encoder measurement mode to **X1**, **X2**, or **X4**, and then set the count to be latched either by the internal "start of scan" signal (default) or by the signal on the mapped counter.

You can optionally perform the following operations:

- Enable gating, so that the counter is enabled when the mapped channel to gate the counter is high. When the mapped channel is low, the counter is disabled but holds the count value.
- Enable "latch on Z" to latch counter outputs using the Encoder Z mapped signal.
- Enable "clear on Z" so that the counter is cleared on the rising edge of the mapped (Z) counter. By default, clear on Z" is disabled, and the counter is not cleared.

USB-1616HS-BNC

The USB-1616HS-BNC supports the following UL and UL for .NET features.

Analog Input

Analog input functions and methods supported

UL:	<code>cbAIn()</code> , <code>cbAInScan()</code> , <code>cbALoadQueue()</code> , <code>cbFileAInScan()</code> , <code>cbAPretrig()</code> *
UL for .NET:	<code>AIn()</code> , <code>AInScan()</code> , <code>ALoadQueue()</code> , <code>FileAInScan()</code> , <code>APretrig()</code> *
	* Pretrigger capability is implemented in software. <code>PretrigCount</code> must be less than the <code>TotalCount</code> and cannot exceed 100000 samples. <code>TotalCount</code> must be greater than the <code>PretrigCount</code> . If a trigger occurs while the number of collected samples is less than the <code>PretrigCount</code> , that trigger will be ignored. Requires a call to <code>cbSetTrigger/SetTrigger</code> for the analog trigger type.
Options:	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, DMAIO, BLOCKIO, EXTTRIGGER*
	* With EXTTRIGGER mode, the first channel in the scan is the analog trigger channel.
HighChan:	0 to 15 (only differential mode available)
Rate:	Up to 1 MHz
Range:	BIP10VOLTS (± 10 V) BIP5VOLTS (± 5 V) BIP2VOLTS (± 2 V) BIP1VOLTS (± 1 V) BIPPT5VOLTS (± 0.5 V) BIPPT2VOLTS (± 0.2 V) BIPPT1VOLTS (± 0.1 V)

Analog Output

Analog output functions and methods supported

UL:	<code>cbAOut()</code> , <code>cbAOutScan()</code>
UL for .NET:	<code>AOut()</code> , <code>AOutScan()</code>
Options:	BACKGROUND, CONTINUOUS, SIMULTANEOUS, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK
	NONSTREAMEDIO can only be used with the number of samples set equal to the size of the FIFO or less. The FIFO holds 524288 samples.
HighChan:	0 to 1
Rate:	1 MHz
Range:	Ignored - Not programmable; fixed at BIP10VOLTS (± 10 volts)
DataValue:	0 to 65535 (Refer to "16-bit values using a signed integer data type" on page 16 for information on 16-bit values using unsigned integers).
Pacing:	Hardware pacing, external or internal clock supported.

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigPort()
UL for .NET:	DConfigPort()
PortNum:	FIRSTPORTA, FIRSTPORTB

Port I/O functions, methods, and argument values supported

UL:	cbDIn(), cbDOut(), cbDInScan(), cbDOutScan() *
UL for .NET:	DIn(), DOut(), DInScan(), DOutScan() *

*FIRSTPORTA and FIRSTPORTB must be set for output to use this function.

Refer to "DIO PortNum" on page 119 for more information.

Options:	BACKGROUND, CONTINUOUS, EXTCLOCK, EXTTRIGGER, WORDXFER, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK
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The EXTCLOCK option can only be used with cbDInScan()/DInScan().

The EXTTRIGGER option can only be used with cbDInScan()/DInScan(). You can use the cbSetTrigger()/SetTrigger() to program the trigger for rising edge, falling edge, or the level of the digital trigger input (TTL).

The WORDXFER option can only be used with FIRSTPORTA.

The NONSTREAMEDIO, ADCCLOCKTRIG, and ADCCLOCK options can only be used with cbDOutScan()/DOutScan().

The NONSTREAMEDIO option can only be used with the number of samples set equal to the size of the FIFO or less. The FIFO holds 524288 samples.

Rate:	12 MHz
PortNum:	FIRSTPORTA, FIRSTPORTB
DataValue:	0 to 255 0 to 65535 using the WORDXFER option with FIRSTPORTA

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn(), cbDBitOut()
UL for .NET:	DBitIn(), DBitOut()
PortType:	FIRSTPORTA
BitNum:	0 to 23

Counter Input

Counter functions and methods supported

UL:	cbCIn(), cbCIn32(), cbCConfigScan(), cbCInScan(), cbCClear()
UL for .NET:	CIn(), CIn32(), CConfigScan(), CInScan(), CClear()

Note: Counters on these devices are zero-based (the first counter number is "0").

Counter argument values

Rate:	6 MHz
CounterNum:	0 to 3

Options:	BACKGROUND, CONTINUOUS, EXTTRIGGER
	You can use <code>cbSetTrigger()/SetTrigger()</code> to program the trigger for rising edge, falling edge, or the level of the digital trigger input (TTL).
LoadValue:	0 to 65535
	Refer to "16-bit values using a signed integer data type" on page 16 for information on 16-bit values using unsigned integers.

Timer Output

Timer functions and methods supported

UL:	<code>cbTimerOutStart()</code> , <code>cbTimerOutStop()</code>
UL for .NET:	<code>TimerOutStart()</code> , <code>TimerOutStop()</code>

Timer argument values

TimerNum:	0 to 1
Frequency:	15.260 Hz to 1.0 MHz

Triggering

Trigger functions and methods supported

UL:	<code>cbSetTrigger()</code>
UL for .NET:	<code>SetTrigger()</code>

Trigger argument values

TrigType	TRIGABOVE, TRIGBELOW, TRIGHIGH, TRIGLOW, TRIGPOSEDGE, TRIGNEGEDGE
	Digital triggering (TRIGHIGH, TRIGLOW, TRIGPOSEDGE, TRIGNEGEDGE) is not supported for pre-trigger acquisitions (<code>cbAPretrig()/ATrig()</code>). Analog triggering (TRIGABOVE, TRIGBELOW) is not supported for <code>cbDInScan()/DInScan()</code> and <code>cbCInScan()/CInScan()</code> .
Threshold	Analog hardware triggering, 12-bit resolution: 0 to 4095 (supported for <code>cbAInScan()/AInScan()</code> only) Analog software triggering, 16-bit resolution: 0 to 65535 (supported for <code>cbAPretrig()/ATrig()</code> only)

DAQ input

DAQ input functions and methods supported

UL:	<code>cbDaqInScan()</code>
UL for .NET:	<code>DaqInScan()</code>

DAQ input argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, DMAIO, BLOCKIO, EXTTRIGGER
ChanTypeArray	ANALOG, DIGITAL8, DIGITAL16, CTR16, CTR32LOW, CTR32HIGH, SETPOINTSTATUS
ChanArray	ANALOG: 0 to 15 (only differential mode available)
DIGITAL8:	FIRSTPORTA, FIRSTPORTB
DIGITAL16:	FIRSTPORTA
CTR16:	0-3 counters
CTR32LOW:	0-3 counters

	CTR32HIGH:	0-3 counters
	SETPOINTSTATUS:	16-bit port that indicates the current state of the 16 possible setpoints.
	ChanTypeArray flag value:	
	SETPOINT_ENABLE:	Enables a setpoint. Refer to "Hardware considerations" on page 118 for more information.
Rate	Analog:	Up to 1 MHz
	Digital:	Up to 12 MHz if no analog channel is selected. Otherwise up to 1 MHz.
	Counter:	Up to 12 MHz if no analog channel is selected. Otherwise up to 1 MHz.
GainArray	ANALOG only; ignore for other ChanTypeArray values.	
	BIP10VOLTS	(± 10 V)
	BIP5VOLTS	(± 5 V)
	BIP2VOLTS	(± 2 V)
	BIP1VOLTS	(± 1 V)
	BIPPT5VOLTS	(± 0.5 V)
	BIPPT2VOLTS	(± 0.2 V)
	BIPPT1VOLT	(± 0.1 V)
PreTrigCount	100000 max	

DAQ triggering

DAQ trigger functions and methods supported

UL:	cbDaqSetTrigger()
UL for .NET:	DaqSetTrigger()

DAQ trigger argument values

TrigSource	TRIG_IMMEDIATE, TRIG_EXTTTL, TRIG_ANALOGHW, TRIG_ANALOGSW, TRIG_DIGPATTERN, TRIG_COUNTER, TRIG_SCANCOUNT
TrigSense	RISING_EDGE, FALLING_EDGE, ABOVE_LEVEL, BELOW_LEVEL, EQ_LEVEL, NE_LEVEL
TrigEvent	START_EVENT, STOP_EVENT

DAQ setpoint

DAQ setpoint functions and methods supported

UL:	cbDaqSetSetpoints()
UL for .NET:	DaqSetSetpoints()

DAQ setpoint argument values

SetpointFlagsArray	SF_EQUAL_LIMITA, SF_LESSTHAN_LIMITA, SF_GREATERTHAN_LIMITB, SF_OUTSIDE_LIMITS, SF_HYSTERESIS, SF_UPDATEON_TRUEONLY, SF_UPDATEON_TRUEANDFALSE
SetpointOutputArray	SO_NONE, SO_FIRSTPORTC, SO_TMR0, SO_TMR1, SO_DAC0, SO_DAC1
LimitAArray	Any value valid for the associated input channel Ignored for SF_GREATERTHAN_LIMITB

LimitBArray	Any value valid for the associated input channel and less than LimitA Ignored for SF_EQUAL_LIMITA, SF_LESSTHAN_LIMITA
Output#Array	For SetpointOutputArray = SO_NONE: Ignored For SetpointOutputArray = SO_TMR#: 0 (to disable timer) or 15.26 to 1000000 (to set output frequency) For SetpointOutputArray = SO_DAC#: Voltage values between -10 and +10
OutputMask#Array	Ignored
SetpointCount	0 (to disable setpoints) to 16

DAQ output

DAQ output functions and methods supported

UL:	cbDaqOutScan()
UL for .NET:	DaqOutScan()

DAQ output argument values

Options	BACKGROUND, CONTINUOUS, SIMULTANEOUS, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK	
ChanType	ANALOG, DIGITAL16	
ChanArray	ANALOG:	0 to 1
	DIGITAL16:	FIRSTPORTA (FIRSTPORTB must be configured as an output)
Rate	ANALOG:	Up to 1 MHz
	DIGITAL16:	Up to 12 MHz (system-dependent) if no analog channel is selected. Otherwise up to 1 MHz.
Range	BIP10VOLTS	(± 10 V)

Hardware considerations

Channel count

For input and output scans, the count must be set to an integer multiple of the number of channels or a BADCOUNT error is returned.

Sampling and update rates

Sampling and update rates are system-dependent. Data overruns/underruns may occur with higher sampling rates when using BACKGROUND and CONTINUOUS modes. To avoid this, use a larger buffer/count size, or use NONSTREAMEDIO mode, if supported. The minimum size buffer is 256 for cbAOutScan()/AOutScan(). Values less than that result in a BADBUFFERSIZE error.

Settling time

For most applications, settling time should be left at the default value of 1 μ s. However, if you are scanning multiple channels and one or more channels are connected to a high impedance source, you may get better results by increasing the settling time. Keep in mind that increasing the settling time reduces the maximum acquisition rate. You can set the time between A/D conversions with the ADC Settling Time option in InstaCal. Select between 1 μ s, 5 μ s, 10 μ s, or 1 ms.

Setpoints

You enable setpoints with the `SETPOINT_ENABLE` flag. This flag must be OR'ed with the `ChanTypeArray` argument values. You set the setpoint criteria with `cbDaqSetSetpoints()/DaqSetSetpoints()`. The number of channels set with the `SETPOINT_ENABLE` flag must match the number of setpoints set by the `SetpointCount` argument (`cbDaqSetSetpoints()/DaqSetSetpoints()`).

Output non-streamed data to a DAC output channel

With `NONSTREAMEDIO` mode, you can output non-streamed data to a specific DAC output channel. The aggregate size of the data output buffer must be less than or equal to the size of the internal data output FIFO in the device. The FIFO holds 524288 samples. This allows the data output buffer to be loaded into the device's internal output FIFO. Once the sample updates are transferred or downloaded to the device, the device is responsible for outputting the data. You can't change the output buffer once the output begins.

Trigger DAC output operations with the ADC clock

Specify the `ADCCLOCKTRIG` option to trigger a data output operation upon the start of the ADC clock.

DIO PortNum

For `cbDOutScan()/DOutScan()` and `cbDaqOutScan()/DaqOutScan()`, `FIRSTPORTA` and `FIRSTPORTB` are treated as one 16-bit port. These functions can only be used with `FIRSTPORTA`. You must configure both `FIRSTPORTA` and `FIRSTPORTB` for output using `cbDConfigPort()/DConfigPort()`.

Quadrature encoder operations

To configure a counter channel as a multi-axis quadrature encoder, use the `cbCConfigScan()/CConfigScan()` `Mode` argument values to set a specified counter to encoder mode, set the encoder measurement mode to `X1`, `X2`, or `X4`, and then set the count to be latched either by the internal "start of scan" signal (default) or by the signal on the mapped counter.

You can optionally perform the following operations:

- Enable gating, so that the counter is enabled when the mapped channel to gate the counter is high. When the mapped channel is low, the counter is disabled but holds the count value.
- Enable "latch on Z" to latch counter outputs using the Encoder Z mapped signal.
- Enable "clear on Z" so that the counter is cleared on the rising edge of the mapped (Z) counter. By default, clear on Z" is disabled, and the counter is not cleared.

USB-2500 Series

The USB-2500 Series includes the USB-2523, USB-2527, USB-2533, and USB-2537 devices.

Analog input

Analog input functions and methods supported

UL:	<code>cbAIn()</code> , <code>cbAInScan()</code> , <code>cbALoadQueue()</code> , <code>cbFileAInScan()</code> , <code>cbATrig()</code> , <code>cbAPretrig()</code> *
UL for .NET:	<code>AIn()</code> , <code>AInScan()</code> , <code>ALoadQueue()</code> , <code>FileAInScan()</code> , <code>ATrig()</code> , <code>APretrig()</code> *
	* Pretrigger capability is implemented in software. <code>PretriggerCount</code> must be less than the <code>TotalCount</code> and cannot exceed 100000 samples. <code>TotalCount</code> must be greater than the <code>PretriggerCount</code> . If a trigger occurs while the number of collected samples is less than the <code>PretriggerCount</code> , that trigger will be ignored. Requires a call to <code>cbSetTrigger (SetTrigger)</code> for the analog trigger type.

Analog input argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, DMAIO, BLOCKIO, EXTTRIGGER	
	With EXTTRIGGER mode, the first channel in the scan is the analog trigger channel.	
HighChan	USB-2537, USB-2533:	
	0 to 63 in single-ended mode, 0 to 31 in differential mode	
	USB-2527, USB-2523:	
	0 to 15 in single-ended mode, 0 to 7 in differential mode	
Rate	Up to 1 MHz	
Range	BIP10VOLTS	(± 10 V)
	BIP5VOLTS	(± 5 V)
	BIP2VOLTS	(± 2 V)
	BIP1VOLTS	(± 1 V)
	BIPPT5VOLTS	(± 0.5 V)
	BIPPT2VOLTS	(± 0.2 V)
	BIPPT1VOLTS	(± 0.1 V)

Analog output (USB-2537 and USB-2527 only)

Analog output functions and methods supported

UL:	<code>cbAOut()</code> , <code>cbAOutScan()</code>
UL for .NET:	<code>AOut()</code> , <code>AOutScan()</code>

Analog output argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, SIMULTANEOUS, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK
	NONSTREAMEDIO can only be used with the number of samples set equal to the size of the FIFO or less. The FIFO holds 524288 samples.
HighChan	0 to 3
Rate	1 MHz
Range	Ignored - Not programmable; fixed at BIP10VOLTS (±10 volts)
DataValue	0 to 65535 (Refer to "16-bit values using a signed integer data type" on page 16 for information on 16-bit values using unsigned integers).

Pacing Hardware pacing, external or internal clock supported.

Digital I/O

Configuration functions, methods, and argument values supported

UL: cbDConfigPort ()

UL for .NET: DConfigPort ()

PortNum FIRSTPORTA, FIRSTPORTB, FIRSTPORTC

Port I/O functions, methods, and argument values supported

UL: cbDIn (), cbDOut (), cbDInScan (), cbDOutScan () *

UL for .NET: DIn (), DOut (), DInScan (), DOutScan () *

**FIRSTPORTA and FIRSTPORTB must be set for output to use this function. Refer to DIO PortNum on page 126 for more information.*

Options BACKGROUND, CONTINUOUS, EXTCLOCK, EXTTRIGGER, WORDXFER, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK

The EXTTRIGGER option can only be used with the cbDInScan () function. You can use the cbSetTrigger () function to program the trigger for rising edge, falling edge, or the level of the digital trigger input (TTL).

The WORDXFER option can only be used with FIRSTPORTA.

The NONSTREAMEDIO, ADCCLOCKTRIG, and ADCCLOCK options can only be used with the cbDOutScan () function.

The NONSTREAMEDIO option can only be used with the number of samples set equal to the size of the FIFO or less. The FIFO holds 524288 samples.

Rate 12 MHz

PortNum FIRSTPORTA, FIRSTPORTB, FIRSTPORTC

DataValue 0 to 255

 0 to 65535 using the WORDXFER option with FIRSTPORTA

Bit I/O functions, methods, and argument values supported

UL: cbDBitIn (), cbDBitOut ()

UL for .NET: DBitIn (), DBitOut ()

PortType FIRSTPORTA

BitNum 0 to 23

Counter input

Counter functions and methods supported

UL: cbCIn (), cbCIn32 (), cbCConfigScan (), cbCInScan (), cbCClear ()

UL for .NET: CIn (), CIn32 (), CConfigScan (), CInScan (), CClear ()

Note: Counters on these devices are zero-based (the first counter number is "0").

Counter argument values

Rate 6 MHz

CounterNum 0 to 3

Options BACKGROUND, CONTINUOUS, EXTTRIGGER

You can use the `cbSetTrigger()` function to program the trigger for rising edge, falling edge, or the level of the digital trigger input (TTL).

LoadValue

0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers.)

Timer output

Timer functions and methods supported

UL: `cbTimerOutStart()`, `cbTimerOutStop()`

UL for .NET: `TimerOutStart()`, `TimerOutStop()`

Timer argument values

TimerNum 0 to 1

Frequency 15.260 Hz to 1.0 MHz

Triggering

Trigger functions and methods supported

UL: `cbSetTrigger()`

UL for .NET: `SetTrigger()`

Trigger argument values

TrigType TRIGABOVE, TRIGBELOW, TRIGHIGH, TRIGLOW, TRIGPOSEDGE, TRIGNEGEDGE

Digital triggering (TRIGHIGH, TRIGLOW, TRIGPOSEDGE, TRIGNEGEDGE) is not supported for pre-trigger acquisitions (`cbAPretrig()` function). Analog triggering (TRIGABOVE, TRIGBELOW) is not supported for the `cbDInScan()` function and the `cbCInScan()` function.

Threshold Analog hardware triggering, 12-bit resolution:
0 to 4095 (supported for `cbAInScan()` only)

Analog software triggering, 16-bit resolution:
0 to 65535 (supported for `cbAPretrig()` only)

Temperature input

Temperature input functions and methods supported

UL: `cbTIn()`, `cbTInScan()`, `cbGetTCValues()`

UL for .NET: `TIn()`, `TInScan()`, `GetTCValues()`

Temperature input argument values

Options NOFILTER

Scale CELSIUS, FAHRENHEIT, KELVIN

HighChan 0 to 3

DAQ input

DAQ input functions and methods supported

UL: `cbDaqInScan()`

UL for .NET: `DaqInScan()`

DAQ input argument values

Options BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, DMAIO, BLOCKIO, EXTTRIGGER

ChanTypeArray	ANALOG, DIGITAL8, DIGITAL16, CTR16, CTR32LOW, CTR32HIGH, CJC, TC, SETPOINTSTATUS
	Note: for information on associating CJC channels with TC channels, refer to Hardware considerations on page 125.
ChanArray	<p>ANALOG: USB-2537, USB-2533: 0 to 63 in single-ended mode, 0 to 31 in differential mode</p> <p> USB-2527, USB-2523: 0 to 15 in single-ended mode, 0 to 7 in differential mode</p> <p>DIGITAL8: FIRSTPORTA, FIRSTPORTB, FIRSTPORTC</p> <p>DIGITAL16: FIRSTPORTA</p> <p>CTR16: 0-3 counters</p> <p>CTR32LOW: 0-3 counters</p> <p>CTR32HIGH: 0-3 counters</p> <p>CJC: 0 to 2</p> <p>TC: 0 to 3</p> <p>SETPOINTSTATUS: 16-bit port that indicates the current state of the 16 possible setpoints.</p> <p>ChanTypeArray flag value:</p> <p>SETPOINT_ENABLE: Enables a setpoint. Refer to Hardware considerations on page 125 for more information.</p>
Rate	<p>Analog: Up to 1 MHz</p> <p>Digital: Up to 12 MHz if no analog channel is selected. Otherwise up to 1 MHz.</p> <p>Counter: Up to 12 MHz if no analog channel is selected. Otherwise up to 1 MHz.</p>
GainArray	<p>ANALOG only; ignore for other ChanTypeArray values.</p> <p>BIP10VOLTS (± 10 V)</p> <p>BIP5VOLTS (± 5 V)</p> <p>BIP2VOLTS (± 2 V)</p> <p>BIP1VOLTS (± 1 V)</p> <p>BIPPT5VOLTS (± 0.5 V)</p> <p>BIPPT2VOLTS (± 0.2 V)</p> <p>BIPPT1VOLT (± 0.1 V)</p>
PreTrigCount	100000 max

DAQ triggering

DAQ trigger functions and methods supported

UL:	cbDaqSetTrigger()
UL for .NET:	DaqSetTrigger()

DAQ trigger argument values

TrigSource	TRIG_IMMEDIATE, TRIG_EXTTTL, TRIG_ANALOGHW, TRIG_ANALOGSW, TRIG_DIGPATTERN, TRIG_COUNTER, TRIG_SCANCOUNT
------------	---

TrigSense	RISING_EDGE, FALLING_EDGE, ABOVE_LEVEL, BELOW_LEVEL, EQ_LEVEL, NE_LEVEL
TrigEvent	START_EVENT, STOP_EVENT

DAQ setpoint

DAQ setpoint functions and methods supported

UL:	cbDaqSetSetpoints()
UL for .NET:	DaqSetSetpoints()

DAQ setpoint argument values

SetpointFlagsArray	SF_EQUAL_LIMITA, SF_LESSTHAN_LIMITA, SF_GREATERTHAN_LIMITB, SF_OUTSIDE_LIMITS, SF_HYSTERESIS, SF_UPDATEON_TRUEONLY, SF_UPDATEON_TRUEANDFALSE
--------------------	--

SetpointOutputArray	SO_NONE, SO_FIRSTPORTC, SO_TMR0, SO_TMR1
---------------------	--

also available for USB-2537 and USB-2527:

	SO_DAC0, SO_DAC1, SO_DAC2, SO_DAC3
LimitAArray	Any value valid for the associated input channel Ignored for SF_GREATERTHAN_LIMITB
LimitBArray	Any value valid for the associated input channel and less than LimitA Ignored for SF_EQUAL_LIMITA, SF_LESSTHAN_LIMITA
Output#Array	For SetpointOutputArray = SO_NONE: Ignored For SetpointOutputArray = SO_FIRSTPORTC: 0 to 65535 For SetpointOutputArray = SO_TMR#: 0 (to disable timer) or 15.26 to 1000000 (to set output frequency) For SetpointOutputArray = SO_DAC#: Voltage values between -10 and +10
OutputMask#Array	For SetpointOutputArray = SO_FIRSTPORTC: 0 to 65535 For SetpointOutputArray = all other values: Ignored
SetpointCount	0 (to disable setpoints) to 16

DAQ output (USB-2537 and USB-2527 only)

DAQ output functions and methods supported

UL:	cbDaqOutScan()
UL for .NET:	DaqOutScan()

DAQ output argument values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, SIMULTANEOUS, NONSTREAMEDIO, ADCCLOCKTRIG, ADCCLOCK
ChanType	ANALOG, DIGITAL16
ChanArray	ANALOG: 0 to 3

	DIGITAL16:	FIRSTPORTA (FIRSTPORTB must be configured as an output)
Rate	ANALOG:	Up to 1 MHz
	DIGITAL16:	Up to 12 MHz (system-dependent) if no analog channel is selected. Otherwise up to 1 MHz.
Range	Ignored	

Hardware considerations

Associating CJC channels with TC channels

The TC channels must immediately follow their associated CJC channels in the channel array. For accurate thermocouple readings, associate CJC0 with TC0, CJC1 with TC1 and TC2, and CJC2 with TC3.

The board must be configured for differential inputs when using thermocouples

TC inputs are supported by differential mode configuration only.

Channel count

For input and output scans, the count must be set to an integer multiple of the number of channels or a BADCOUNT error is returned.

Sampling and update rates

Sampling and update rates are system-dependent. Data overruns/underruns may occur with higher sampling rates when using BACKGROUND and CONTINUOUS modes. To avoid this, use a larger buffer/count size, or use NONSTREAMEDIO mode, if supported. The minimum size buffer is 256 for cbAOutScan(). Values less than that result in a BADBUFFERSIZE error.

Settling time

For most applications, settling time should be left at the default value of 1 μ s. However, if you are scanning multiple channels and one or more channels are connected to a high impedance source, you may get better results by increasing the settling time. Keep in mind that increasing the settling time reduces the maximum acquisition rate. You can set the time between A/D conversions with the ADC Settling Time option in InstaCal. Select between 1 μ s, 5 μ s, 10 μ s, or 1 ms.

Setpoints

You enable setpoints with the SETPOINT_ENABLE flag. This flag must be OR'ed with the ChanTypeArray argument values. You set the setpoint criteria with cbDaqSetSetpoints()/DaqSetSetpoints(). The number of channels set with the SETPOINT_ENABLE flag must match the number of setpoints set by the SetpointCount argument (cbDaqSetSetpoints()/DaqSetSetpoints()).

Output non-streamed data to a DAC output channel

With NONSTREAMEDIO mode, you can output non-streamed data to a specific DAC output channel. The aggregate size of the data output buffer must be less than or equal to the size of the internal data output FIFO in the device. The FIFO holds 524288 samples. This allows the data output buffer to be loaded into the device's internal output FIFO. Once the sample updates are transferred or downloaded to the device, the device is responsible for outputting the data. You can't change the output buffer once the output begins.

Trigger DAC output operations with the ADC clock

Specify the ADCCLOCKTRIG option to trigger a data output operation upon the start of the ADC clock.

DIO PortNum

For `cbDOutScan()/DOutScan()` and `cbDaqOutScan()/DaqOutScan()`, `FIRSTPORTA` and `FIRSTPORTB` are treated as one 16-bit port. These functions can only be used with `FIRSTPORTA`. You must configure both `FIRSTPORTA` and `FIRSTPORTB` for output using the `cbDConfigPort()` function.

Synchronous scanning with multiple boards

You can operate up to four USB-2500 Series boards synchronously by setting the direction of the A/D and D/A pacer pins (**XAPCR** or **XDPCR**) in *InstaCal*.

On the board used to pace each device, set the pacer pin that you want to use (XAPCR or XDPCR) for *Output*. On the board(s) that you want to synchronize with this board, set the pacer pin that you want to use (XAPCR or XDPCR) for *Input*.

You set the direction using the *InstaCal* configuration dialog's **XAPCR Pin Direction** and **XDPCR Pin Direction** settings. If you have an older version of *InstaCal*, these settings might be labeled "ADC Clock Output" (set to *Enabled* to configure XAPCR for output) or "DAC Clock Output" (set to *Enabled* to configure XDPCR for output).

Wire the pacer pin configured for output to each of the pacer input pins that you want to synchronize.

DEMO-BOARD

The **DEMO-BOARD** is a software simulation of a data acquisition board that simulates analog input and digital I/O operations.

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options `BACKGROUND`, `CONTINUOUS`, `SINGLEIO`, `DMAIO`

HighChan 7 max

Rate 300000

Digital I/O

Digital I/O functions and methods supported

UL: `cbDIn()`, `cbDBitIn()`, `cbDInScan()`, `cbDOut()`, `cbDBitOut()`, `cbDOutScan()`,
`cbDConfigPort()`

UL for .NET: `DIn()`, `DBitIn()`, `DInScan()`, `DOut()`, `DBitOut()`, `DOutScan()`, `DConfigPort()`

Digital I/O argument values

PortNum `FIRSTPORTA`, `FIRSTPORTB`, `AUXPORT`

DataValue 0 to 255 using `FIRSTPORTA`, `FIRSTPORTB`, or `AUXPORT`

BitNum 0 to 15 using `FIRSTPORTA`
0 to 7 using `AUXPORT`

Using the DEMO-BOARD

Analog input

The **DEMO-BOARD** simulates eight channels of 16-bit analog input. *InstaCal* is used to configure the following waveforms on the analog input channels:

- sine wave
- square wave
- saw-tooth, ramp
- damped sine wave
- input from a data file

The data file is a streamer file, so any data that has been previously saved in a streamer file can be used as a source of demo data by the board. Data files are named `DEMO0.DAT` through `DEMO7.DAT`. When a data file is assigned to a channel, the library tries to extract data for that channel from the streamer file. If data for that channel does not exist, then the first (and possibly only) channel data in the streamer is extracted and used.

For example, `DEMO2.DAT` is assigned as the data source for channel 5 on the DEMO-BOARD. The library will try to extract data from the file that corresponds to channel 5. If `DEMO2.DAT` has scan data that corresponds to channels 0 through 15, then channel 5 data is extracted. If `DEMO2.DAT` only has data for a single channel, the data for that channel is used as the data source for channel 5.

Digital I/O

The **DEMO-BOARD** simulates the following:

- One eight-bit `AUXPORT` configurable digital input/output port. Each bit of the `AUXPORT` generates a square wave with a different period.
- Two eight-bit configurable digital I/O ports—`FIRSTPORTA`, `FIRSTPORTB`—which can be used for high speed scanning. `FIRSTPORTA` functions like `AUXPORT` in that it generates square waves. Each bit of `FIRSTPORTB` generates a pulse with a different frequency.

Analog Output Boards

Introduction

All boards with analog outputs support the `cbAOut()` and `cbAOutScan()` functions. Boards released after the printing of this manual are described in Readme files on the Universal Library disk.

`cbAOutScan()` / `AOutScan()` are designed primarily for boards that support hardware-paced analog output, but it is also useful when simultaneous update of all channels is desired. If the hardware is configured for simultaneous update, this function loads each DAC channel with the appropriate value before issuing the update command.

DAC04 HS Series

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options `BACKGROUND`, `CONTINUOUS`, `EXTCLOCK`, `SIMULTANEOUS`

HighChan 0 to 3

Rate 500000

Range Ignored - Not programmable

DataValue 0 to 4095

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`

Digital I/O argument values

PortNum `AUXPORT*`

DataValue 0 to 255

BitNum 0 to 7

* `AUXPORT` is not configurable for these boards.

Hardware considerations

Pacing analog output

Hardware pacing, external or internal clock supported.

The external clock is hardwired to the DAC pacer. If an internal clock is to be used, do not connect a signal to the External Pacer input.

DAC Series (Excluding HS Series)

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options `SIMULTANEOUS`

HighChan	DAC02	DAC08
	0 to 1	0 to 7

DAC06	DAC16
0 to 5	0 to 15

Rate Ignored

Count `HighChan - LowChan + 1` max

Range Ignored - Not programmable

DataValue 0 to 4095

For the **/16 series**, the following argument values are also valid:
0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for
information on 16-bit values using unsigned integers.)

Hardware considerations

Pacing analog output

Software only

PCI-DAC6700 Series

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

HighChan: **PCI-DAC6702:** 7

PCI-DAC6703: 15

Count: `HighChan - LowChan + 1` max

Rate: Ignored

Range: Ignored - Not programmable; fixed at BIP10VOLTS (± 10.1 V)

DataValue: 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for information on 16-bit values using unsigned integers.)

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`, `cbDConfigPort()`, `cbDConfigBit()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`, `DConfigBit()`

Digital I/O argument values

PortNum: AUXPORT is bitwise configurable for these boards, and must be configured using `cbDConfigBit()` or `cbDConfigPort()` before use as output.

DataValue 0 to 255

BitNum 0 to 7

Configuration

Configuration functions and methods supported

UL: `cbGetConfig()`, `cbSetConfig()`

UL for .NET: `GetDACStartup()`, `GetDACUpdateMode()`, `SetDACStartup()`, `SetDACUpdateMode()`

Configuration argument values

ConfigItem: `BIDACSTARTUP`, `BIDACUPDATEMODE`, `BIDACUPDATECMD`

Hardware considerations

Pacing analog output

Software only

PCM- and PC-CARD- DAC Series

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options	PCM-DAC02	
	Ignored	
	PCM-DAC08 and PC-CARD-DAC08	
	SIMULTANEOUS	
HighChan	DAC02: 0 to 1	
	DAC08: 0 to 7	
Rate	Ignored	
Count	HighChan - LowChan + 1 max	
Range	PCM-DAC08 and PC-CARD-DAC08	
	Ignored - Not programmable; fixed at BIP5VOLTS (± 5 V)	
	PCM-DAC02	
	BIP10VOLTS	BIP5VOLTS
	UNI10VOLTS	UNI5VOLTS
DataValue	0 to 4095	

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`, `cbDConfigPort()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`

Digital I/O argument values

PortNum	FIRSTPORTA, FIRSTPORTB
DataValue	0 to 15 for FIRSTPORTA or FIRSTPORTB
BitNum	0 to 7 using FIRSTPORTA

Hardware considerations

Pacing analog output

Software only

Digital configuration

Supports two configurable 4-bit ports—FIRSTPORTA and FIRSTPORTB. Each can be independently configured as either inputs or outputs via `cbDConfigPort()` or `DConfigPort()`.

PCIM- and CIO- DDA06 Series

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument values

Options `SIMULTANEOUS` (CIO-DDA06 Series only)

HighChan 0 to 5

Count `HighChan - LowChan + 1 max`

Rate Ignored

Range Ignored - Not programmable

DataValue 0 to 4095

For the **/16 series**, the following argument values are also valid
0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16.)

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`, `cbDConfigPort()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`

Digital I/O argument values

PortNum `FIRSTPORTA`, `FIRSTPORTB`, `FIRSTPORTCL`, `FIRSTPORTCH`

DataValue 0 to 15 for `FIRSTPORTC`
0 to 255 for `FIRSTPORTA` or `FIRSTPORTB`

BitNum 0 to 23 using `FIRSTPORTA`

Hardware considerations

Pacing analog output

Software only

Initializing the 'zero power-up' state

When using the **CIO-DDA06** "zero power-up state" hardware option, use `cbAOutScan()` or `AOutScan()` to set the desired output value and enable the DAC outputs.

PCI- and CPCI- DDA Series

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument ranges

Options `SIMULTANEOUS`

HighChan **DDA02:** 0 to 1
DDA04: 0 to 3
DDA08: 0 to 7

Rate Ignored

Count `HighChan - LowChan + 1` max

Range `BIP10VOLTS` `UNI10VOLTS`
`BIP5VOLTS` `UNI5VOLTS`
`BIP2PT5VOLTS` `UNI2PT5VOLTS`

DataValue 0 to 4095

For the **/16 series**, the following argument values are also valid
 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16 for
 information on 16-bit values using unsigned integers.)

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`, `cbDConfigPort()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`

Digital I/O argument values

PortNum `FIRSTPORTA`, `FIRSTPORTB`, `FIRSTPORTCL`, `FIRSTPORTCH`, `SECONDPORTA`,
`SECONDPORTB`, `SECONDPORTCL`, `SECONDPORTCH`

DataValue 0 to 15 for `PORTCH` and `PORTCL`
 0 to 255 for `PORTA` or `PORTB`

BitNum 0 to 47 using `FIRSTPORTA`

Hardware considerations

Pacing analog output

Software only.

cSBX-DDA04

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument ranges

Options `BACKGROUND`, `CONTINUOUS`, `EXTCLOCK`, `SIMULTANEOUS`

Rate 300,000

Pacing Hardware pacing, external or internal clock supported

Digital I/O

Digital I/O functions and methods supported

UL: `cbDIn()`, `cbDOut()`, `cbDBitIn()`, `cbDBitOut()`, `cbDInScan()`, `cbDOutScan()`

UL for .NET: `DIn()`, `DOut()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`

Digital I/O argument values

PortNum `AUXPORT*`

DataValue 0 to 255 using `cbDIn()` or `cbDInScan()`, 0 to 16383

BitNum 0 to 7 using `cbDBitIn()`
0 to 13 using `cbDBitOut()`

Rate 500 kHz (refer to "Notes" below).

Pacing Hardware
* `AUXPORT` is not configurable for this board.

Notes

The cSBX-DDA04 board allows interleaving of analog and digital output data. To support interleaving, a control bit indicates the data type. The control bit is the MSB of each 16-bit word of analog or digital data. The MSB = 0 for analog data, and 1 for digital data. The data is passed to the board and then directed to the correct output type by hardware on the board which detects and acts on the MSB control bit.

- To use this interleaving capability with the UL, set `HighChan` and `LowChan` to `NOTUSED`, and indicate the data type and channel in the most significant four bits of the data values in the buffer.
- To use this interleaving capability with the UL for .NET, set `HighChan` and `LowChan` to `NOTUSED`, and indicate the data type and channel in the most significant four bits of the data values in the buffer.

USB-3100 Series

The USB-3100 Series includes the USB-3101, USB-3102, USB-3103, USB-3104, USB-3105, USB-3106, USB-3110, USB-3112, and USB-3114 devices.

Analog output

Analog output functions and methods supported

UL: `cbAOut()`, `cbAOutScan()`

UL for .NET: `AOut()`, `AOutScan()`

Analog output argument ranges

Options `SIMULTANEOUS` (`cbAOutScan()` / `AOutScan()` only)

HighChan	USB-3101, USB-3102, and USB-3110:	0 to 3
	USB-3103, USB-3104, and USB-3112:	0 to 7
	USB-3105, USB-3106, and USB-3114:	0 to 15

Rate Ignored

Count `HighChan - LowChan + 1` max

Range Ignored - Not programmable; selectable for `BIP10VOLTS` (± 10 V), `UNI10VOLTS` (0 to 10 V), or `MA0TO20` (0 to 20 mA) via *InstaCal*

USB-3102, USB-3104, USB-3106:

Also selectable for `MA0TO20` (0 to 20mA) via *InstaCal*

DataValue 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16.)

Digital I/O

Configuration functions, methods, and argument values supported

UL: `cbDConfigBit()`, `cbDConfigPort()`

UL for .NET: `DConfigBit()`, `DConfigPort()`

PortNum `AUXPORT`

PortType `AUXPORT`

Port I/O functions, methods, and argument values supported

UL: `cbDOut()`, `cbDIn()`

UL for .NET: `DOut()`, `DIn()`

PortNum `AUXPORT`

DataValue 0 to 255 for `AUXPORT`

Bit I/O functions, methods, and argument values supported

UL: `cbDBitIn()`, `cbDBitOut()`

UL for .NET: `DBitIn()`, `DBitOut()`

PortType `AUXPORT`

BitNum 0 to 7 on `AUXPORT`

Counter I/O

Counter I/O functions and methods supported

UL: `cbCIn () *`, `cbCIn32 ()`, `cbCLoad () **`, `cbCLoad32 () **`

UL for .NET: `CIn () *`, `CIn32 ()`, `CLoad () **`, `CLoad32 () **`

*Although `cbCIn ()` and `CIn ()` are valid for use with this counter, `cbCIn32 ()` or `CIn32 ()` may be more appropriate, since the values returned may be greater than the data types used by `cbCIn ()` and `CIn ()` can handle.

**`cbCLoad ()`, `cbCLoad32 ()`, `CLoad ()` and `CLoad32 ()` only accept `Count=0`. These functions are used to reset the counter.

Counter I/O argument values

CounterNum 1

Count $2^{32}-1$ when reading the counter.

LoadValue 0 when loading the counter.

`cbCLoad ()` and `cbCLoad32 ()` / `CLoad ()` and `CLoad32 ()` are only used to reset the counter for this board to 0. No other values are valid.

The “[Basic signed integers](#)” guidelines on page 140 apply when using `cbCIn ()` or `CIn ()` for values greater than 32767, and when using `cbCIn32 ()` or `CIn32 ()` for values greater than 2147483647.

RegNum LOADREG1

Hardware considerations

Scan options

The `SIMULTANEOUS` scan option can only be used with `cbAOutScan ()` / `AOutScan ()`.

Simultaneous mode

Set the direction of the SYNCLD pin (pin 49) with the **Simultaneous Mode** option in *InstaCal* to be either Master (output) or Slave (input).

- Specify the `SIMULTANEOUS` scan option and set the Simultaneous Mode option to **Master** to output the internal D/A LOAD signal on the SYNCLD pin.
- Specify the `SIMULTANEOUS` scan option and set the Simultaneous Mode option to **Slave** to configure the SYNCLD pin to receive the D/A LOAD signal from an external source. Output channels are updated simultaneously when the SYNCLD receives the signal.
In slave mode, analog outputs may either be updated immediately or when a positive edge is seen on the SYNCLD pin (this is under software control.) The SYNCLD pin must be at a low logic level for DAC outputs to update immediately. If an external source is pulling the pin high, no update will occur.

When you do not specify `SIMULTANEOUS`, the analog outputs are updated in sequential order, and the SYNCLD pin is ignored.

External current limiting may be required for high drive devices (USB-3110, USB-3112, USB-3114)

The voltage outputs on the USB-3110, USB-3112, and USB-3114 incorporate high-drive current output capability. The high drive current outputs allow each of the voltage outputs to sink/source up to 40 mA (maximum) of load current.

The voltage outputs should not be kept in a short-circuit condition for longer than the specified 100 ms. For those applications that may potentially exceed the 40 mA maximum current limit or the 100 ms short-circuit condition, external current limiting must be used to prevent potential damage to the USB-3100 series device.

Simultaneous update of voltage and current outputs (USB-3102, USB-3104, USB-3106)

Each voltage output channel on the USB-3102, USB-3104, and USB-3106 has an associated current output. The voltage and current outputs are grouped as channel pairs. Each D/A converter output controls a voltage and current channel pair simultaneously. When you write to a voltage output, its associated current output is also updated. Each channel pair can be updated individually or simultaneously.

Each voltage/current channel pair can be updated individually or simultaneously. Leave each pair of unused voltage and current outputs disconnected.

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the USB LED on a USB device to blink.

When you have several USB devices connected to the computer, use these functions to identify a particular device by making its USB LED blink.

Digital Input/Output Boards

Introduction

This section has details on using digital I/O boards in conjunction with the Universal Library. Boards released after the printing of this manual will be described in Readme files on the Universal Library disk.

Basic signed integers

When reading or writing ports that are 16-bits wide, be aware of the following issue using signed integers (as you are forced to do when using Basic):

On some boards, for example the **PDISO16**, the `AUXPORT` digital ports are set up as one 16-bit port. When using `cbDOut()` or `DOut()`, the digital values are written as a single 16-bit word. Using signed integers, writing values above 0111 1111 1111 1111 (32767 decimal) can be confusing. The next increment, 1000 0000 0000 0000, has a decimal value of -32768. Using signed integers, this is the value that you would use for turning on the MSB only. The value for all bits on is -1. Keep this in mind if you are using Basic, since Basic does not supply unsigned integers (values from 0 to 65536).

To fully understand and maximize the performance of this and other digital input function calls, refer to the 82C55 data sheet in the *Documents* subdirectory of the installation. This data sheet is also available from our web site at www.mccdaq.com/PDFmanuals/82C55A.pdf. Also refer to the 8536 data sheet (this data sheet file is not available in PDF format).

AC5 Series

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`, `cbDConfigPort()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`

Digital I/O argument values

All boards in this series support:

PortNum	<code>FIRSTPORTA</code> , <code>FIRSTPORTB</code> , <code>FIRSTPORTCL</code> , <code>FIRSTPORTCH</code>
DataValue	0 to 15 using <code>FIRSTPORTCL</code> or <code>FIRSTPORTCH</code> 0 to 255 using <code>FIRSTPORTA</code> or <code>FIRSTPORTB</code>
BitNum	0 to 23 using <code>FIRSTPORTA</code>

DUAL-AC5 and QUAD-AC5 boards also support:

PortNum	<code>SECONDPORTA</code> , <code>SECONDPORTB</code> , <code>SECONDPORTCL</code> , <code>SECONDPORTCH</code>
DataValue	0 to 15 using <code>SECONDPORTCL</code> or <code>SECONDPORTCH</code> 0 to 255 using <code>SECONDPORTA</code> or <code>SECONDPORTB</code>
BitNum	0 to 47 using <code>FIRSTPORTA</code>

QUAD-AC5 boards also support:

PortNum	<code>THIRDPORTA</code> , <code>THIRDPORTB</code> , <code>THIRDPORTCL</code> , <code>THIRDPORTCH</code> , <code>FOURTHPORTA</code> , <code>FOURTHPORTB</code> , <code>FOURTHPORTCL</code> , <code>FOURTHPORTCH</code>
DataValue	0 to 15 using <code>THIRDPORTCL</code> or <code>THIRDPORTCH</code> 0 to 255 using <code>THIRDPORTA</code> or <code>THIRDPORTB</code>
BitNum	0 to 95 using <code>FIRSTPORTA</code>

DIO Series

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`, `cbDConfigPort()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`

Digital I/O argument values

PortNum `FIRSTPORTA`, `FIRSTPORTB`, `FIRSTPORTCL`, `FIRSTPORTCH`

For **DIO48**, **DIO48H**, **DIO96**, and **DIO192**, the following values are also valid:
`SECONDPORATA`, `SECONDPORBTB`, `SECONDPORCL`, `SECONDPORCH`

For **DIO96**, and **DIO192**, the following argument values are also valid:
`THIRDPORATA`, `THIRDPORBTB`, `THIRDPORCL`, `THIRDPORCH`, `FOURTHPORATA`,
`FOURTHPORBTB`, `FOURTHPORCL`, `FOURTHPORCH`

For **DIO192**, the following values are also valid:
`FIFTHPORATA` through `EIGHTHPORCH`

DataValue 0 to 15 for `PORTCL` or `PORTCH`
0 to 255 for `PORTA` or `PORTB`

BitNum 0 to 23 using `FIRSTPORTA`

For **DIO48**, **DIO48H**, **DIO96**, and **DIO192**, the following values are also valid:
24 to 47 using `FIRSTPORTA`

For **DIO96**, and **DIO192**, the following values are also valid:
48 to 95 using `FIRSTPORTA`

For **DIO192**, the following values are also valid:
96 to 191

Event notification (CIO- and PCI- DIO24 and DIO24H; PCI-DIO24/LP and PCI-DIO24/S only)

Event notification functions and methods supported

UL: `cbEnableEvent()`, `cbDisableEvent()`

UL for .NET: `EnableEvent()`, `DisableEvent()`

Event notification argument values

EventType `ON_EXTERNAL_INTERRUPT` (UL)/`OnExternalInterrupt` (UL for .NET)

Hardware considerations

Event Notification

DIO Series boards that support event notification only support external rising edge interrupts.

DIO24/CTR3 and D24/CTR3 Series

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`, `cbDConfigPort()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`

Digital I/O argument values

PortNum `FIRSTPORTA`, `FIRSTPORTB`, `FIRSTPORTCL`, `FIRSTPORTCH`

DataValue 0 to 15 for `FIRSTPORTCL` or `FIRSTPORTCH`
0 to 255 for `FIRSTPORTA` or `FIRSTPORTB`

BitNum 0 to 23 using `FIRSTPORTA`

Counter I/O

Counter functions and methods supported

UL: `cbC8254Config()`, `cbCIn()`, `cbCLoad()`

UL for .NET: `C8254Config()`, `CIn()`, `CLoad()`

Counter argument values

CounterNum 1 to 3

Config `HIGHONLASTCOUNT`, `ONESHOT`, `RATEGENERATOR`, `SQUAREWAVE`, `SOFTWARESTROBE`,
`HARDWARESTROBE`

LoadValue 0 to 65535 (Refer to "[16-bit values using a signed integer data type](#)" on page 16.)

RegNum `LOADREG1`, `LOADREG2`, `LOADREG3`

Event notification

CIO-DIO24/CTR3 and PC-CARD-D24/CTR3

Event notification functions and methods supported

UL: `cbEnableEvent()`, `cbDisableEvent()`

UL for .NET: `EnableEvent()`, `DisableEvent()`

Event notification argument values

EventType `ON_EXTERNAL_INTERRUPT`

Hardware considerations

Counter configuration

Counter source functions are programmable using *InstaCal*.

PCI-DIO48/CTR15

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()`

UL for .NET: `DOut(), DIn(), DBitIn(), DBitOut(), DConfigPort()`

Digital I/O argument values

PortNum `FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH, SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH`

DataValue `0 to 15 for FIRSTPORTCL or FIRSTPORTCH
0 to 255 for FIRSTPORTA or FIRSTPORTB`

BitNum `0 to 47 using FIRSTPORTA`

Counter I/O

Counter functions and methods supported

UL: `cbC8254Config(), cbCIn(), cbCLoad()`

UL for .NET: `C8254Config(), CIn(), CLoad()`

Counter argument values

CounterNum `1 to 15`

Config `HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE`

LoadValue `0 to 65535 (Refer to "16-bit values using a signed integer data type" on page 16 for information on 16-bit values using unsigned integers.)`

RegNum: `LOADREG1 - LOADREG15`

Event notification

Event notification functions and methods supported

UL: `cbEnableEvent(), cbDisableEvent()`

UL for .NET: `EnableEvent(), DisableEvent()`

Event notification argument values

EventType `ON_EXTERNAL_INTERRUPT`

PCIe-DIO24 and PCIe-DIO96H

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigPort()
UL for .NET:	DConfigPort()
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH

The PCIe-DIO96H also supports:

SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH, THIRDPORATA, THIRDPORBT, THIRDPORCTL, THIRDPORCH, FOURTHPORTA, FOURTHPORTB, FOURTHPORTCL, FOURTHPORTCH

Port I/O functions, methods, and argument values supported

UL:	cbDOut(), cbDIn()
UL for .NET:	DOut(), DIn()
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH

The PCIe-DIO96H also supports:

SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH, THIRDPORATA, THIRDPORBT, THIRDPORCTL, THIRDPORCH, FOURTHPORTA, FOURTHPORTB, FOURTHPORTCL, FOURTHPORTCH

DataValue	<p>PCIe-DIO24:</p> <p>0 to 15 for FIRSTPORTCL or FIRSTPORTCH</p> <p>0 to 255 for FIRSTPORTA or FIRSTPORTB</p> <p>PCIe-DIO96H:</p> <p>0 to 15 for FIRSTPORTCL, SECONDPORTCL, THIRDPORCTL, or FOURTHPORTCL, FIRSTPORTCH, SECONDPORTCH, THIRDPORCH, or FOURTHPORTCH</p> <p>0 to 255 for FIRSTPORTA, SECONDPORTA, THIRDPORATA, or FOURTHPORTA, FIRSTPORTB, SECONDPORTB, THIRDPORBT, or FOURTHPORTB</p>
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Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn(), cbDBitOut()
UL for .NET:	DBitIn(), DBitOut()
PortType	FIRSTPORTA
BitNum	<p>PCIe-DIO24: 0 to 23 on FIRSTPORTA</p> <p>PCIe-DIO96H: 0 to 96 on FIRSTPORTA</p>

Hardware considerations

Pull-up/down resistor configuration

Each digital port has an associated resistor. You set the up/down configuration of each port's resistor with *InstaCal*. Configuration options are stored in non-volatile memory in EEPROM, and are loaded at power up.

PDISO8 and PDISO16 Series

Digital I/O

Port I/O functions, methods, and argument values supported

UL:	<code>cbDOut()</code> , <code>cbDIn()</code>
UL for .NET:	<code>DOut()</code> , <code>DIn()</code>
PortNum	AUXPORT
DataValue	PDISO8 0 to 255 for AUXPORT PDISO16 0 to 65535 for AUXPORT (Refer to " 16-bit values using a signed integer data type " on page 16 for information on 16-bit values using unsigned integers.)

Bit I/O functions, methods, and argument values supported

UL:	<code>cbDBitIn()</code> , <code>cbDBitOut()</code>
UL for .NET:	<code>DBitIn()</code> , <code>DBitOut()</code>
PortType	AUXPORT
BitNum	PDISO8 0 to 7 on AUXPORT PDISO16 0 to 15 on AUXPORT

Miscellaneous

Miscellaneous functions and methods supported (USB-PDISO8, USB-PDISO8/40, and E-PDISO16 only)

UL:	<code>cbFlashLED()</code>
UL for .NET:	<code>FlashLED()</code>

These functions cause the **USB** LED on a Measurement Computing USB module to blink, and the **LINK** LED on a Measurement Computing Ethernet module to blink.

When you have several USB modules connected to the computer, or Ethernet modules on the network, use these functions to identify a particular module by making its LED blink.

Establishing and requesting control of an E-PDISO16

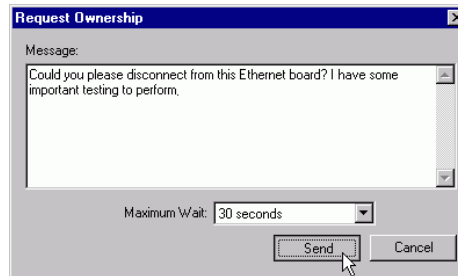
Through *InstaCal*, you can configure the system to automatically attempt to establish control over the E-PDISO16 when an application starts up. To do this, check the "**Try to acquire ownership on application startup**" option on *InstaCal*'s **Ethernet Settings** tab. Note that only one computer should have this option selected; otherwise, two or more computers might compete for control over the E-PDISO16. To manually request control over the E-PDISO16, press the **Request Ownership** button on the **Ethernet Settings** tab.

Only one computer can establish control over an E-PDISO16 at a time. Additional computers that contact the device can only query the state of the device and its ports. The name of the computer with control over the E-PDISO16 appears in the **Device Owner** property on the **Ethernet Settings** tab.

Sending a request for control of an E-PDISO16

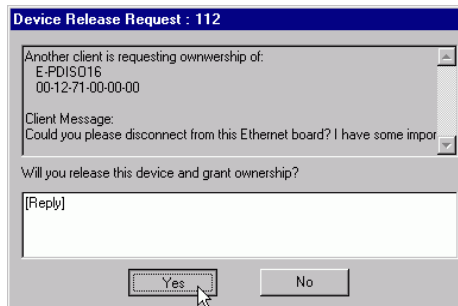
If another computer already has control over E-PDISO16 when you connect to it, you can send a message to the controlling computer. Do the following.

1. From *InstaCal*'s main window, double-click on the E-PDISO16.
2. From the **Ethernet Settings** tab, click on the **Request Ownership** button.
3. On the **Request Ownership** dialog, enter your message (up to 256 characters). Press **Ctrl** and **Enter** to go to a new line. You can set how long the message is displayed on the computer that controls the E-PDISO16 from the **Maximum Wait** drop-down list box.
4. Click on the **Send** button to send the message.



Receiving a request for control of an E-PDISO16

If your computer controls an E-PDISO16 and you receive a message from another person requesting control of the device, the message shows on your screen for the time set in the **Maximum Wait** drop-down list.



- To disconnect and give control of the E-PDISO16 to the person requesting, click on the Yes button.
- To retain control of the E-PDISO16, click on the No button.

Receiving a message

When a computer sends a message to the computer controlling the device, the message displays on the monitor of the controlling computer for the time specified by the **Time-out** value.

The message box has two buttons used to respond to the message. When you receive a message, enter a response in the message box and click on one of the following buttons.

- **Yes:** Click on Yes to give up ownership/control over the network device. The computer automatically disconnects from the network connection, and control over the device transfers to the computer that sent the message. The Device Owner property in *InstaCal* updates with the name of the computer that gained control of the device.
- **No:** Click on No when you do not agree to give up ownership or control over the network device. When you click on a button, the message box and selected response displays on the computer that sent the message.

CIO-PDMA16 and CIO-PDMA32

Digital I/O

Digital I/O functions and methods supported

UL:	<code>cbDOutScan()</code> , <code>cbDInScan()</code> , <code>cbDOut()</code> , <code>cbDIn()</code> , <code>cbDBitIn()</code> , <code>cbDBitOut()</code> , <code>cbDConfigPort()</code>
UL for .NET:	<code>DOutScan()</code> , <code>DInScan()</code> , <code>DOut()</code> , <code>DIn()</code> , <code>DBitIn()</code> , <code>DBitOut()</code> , <code>DConfigPort()</code>

Digital I/O argument values

PortNum	<code>FIRSTPORTA</code> , <code>FIRSTPORTB</code> , <code>AUXPORT</code>
DataValue	0 to 7 using <code>AUXPORT</code> (only <code>cbDOut()</code> is supported), 0 to 255 using <code>FIRSTPORTA</code> and <code>FIRSTPORTB</code> , 0 to 65535 using <code>WORDXFER FIRSTPORTA</code> .
BitNum	0 to 2 using <code>AUXPORT</code> (only <code>cbDBitOut()</code> and <code>DBitOut()</code> are supported), 0 to 15 using <code>PORTA</code> .
Rate	CIO-PDMA16: 125 Kwords CIO-PDMA32: 750 Kwords
Options	<code>BACKGROUND</code> , <code>CONTINUOUS</code> , <code>EXTCLOCK</code> , <code>WORDXFER</code>

Hardware considerations

Digital I/O Pacing

Hardware pacing, external or internal clock supported.

USB-1024 and USB-DIO24 Series

The USB-1024LS, USB-1024HLS, USB-DIO24/37, and USB-DIO24H/37 support the following UL and UL for .NET features.

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigPort ()
UL for .NET:	DConfigPort ()
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH

Port I/O functions, methods, and argument values supported

UL:	cbDOut (), cbDIn ()
UL for .NET:	DOut (), DIn ()
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for FIRSTPORTCL or FIRSTPORTCH 0 to 255 for FIRSTPORTA or FIRSTPORTB

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn (), cbDBitOut ()
UL for .NET:	DBitIn (), DBitOut ()
PortType	FIRSTPORTA
BitNum	0 to 23 on FIRSTPORTA

Counter I/O

Counter functions and methods supported

UL:	cbCIn () *, cbCIn32 (), cbCLoad () **, cbCLoad32 () **
UL for .NET:	CIn () *, CIn32 (), CLoad () **, CLoad32 () ** *Although cbCIn () and CIn () are valid for use with this counter, cbCIn32 () or CIn32 () may be more appropriate, since the values returned may be greater than the data types used by cbCIn () and CIn () can handle. **cbCLoad (), cbCLoad32 (), CLoad () and CLoad32 () only accept Count=0. These functions are used to reset the counter.

Counter argument values

CounterNum	1
Count	0 to 2 ³² -1 when reading the counter.
LoadValue	0 when loading the counter. cbCLoad () and cbCLoad32 () / CLoad () and CLoad32 () are only used to reset the counter for this board to 0. No other values are valid. The “Basic signed integers” guidelines on page 140 apply when using cbCIn () or CIn () for values greater than 32767, and when using cbCIn32 () or CIn32 () for values greater than 2147483647.
RegNum	LOADREG1

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the LED on a USB device to blink.

When you have several USB devices connected to the computer, use these functions to identify a particular device by making its LED blink.

USB-DIO96 Series (formerly USB-1096 Series)

The USB-DIO96H, USB-DIO96H/50, and USB-1096HFS support the following UL and UL for .NET features.

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigPort ()
UL for .NET:	DConfigPort ()
PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH, SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH, THIRDPORTA, THIRDPORTB, THIRDPORTCL, THIRDPORTCH, FOURTHPORTA, FOURTHPORTB, FOURTHPORTCL, FOURTHPORTCH

Port I/O functions, methods, and argument values supported

UL:	cbDOut (), cbDIn ()
UL for .NET:	DOut (), DIn ()
PortNum	PORTA, PORTB, PORTCL, PORTCH
DataValue	0 to 15 for PORTCL or PORTCH 0 to 255 for PORTA or PORTB

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn (), cbDBitOut ()
UL for .NET:	DBitIn (), DBitOut ()
PortType	FIRSTPORTA
BitNum	0 to 95 on FIRSTPORTA

Counter I/O

Counter functions and methods supported

UL:	cbCIn () *, cbCIn32 (), cbCLoad () **, cbCLoad32 () **
UL for .NET:	CIn () *, CIn32 (), CLoad () **, CLoad32 () **
	<p>*Although <code>cbCIn ()/CIn ()</code> are valid for use with this counter, <code>cbCIn32 ()</code> or <code>CIn32 ()</code> may be more appropriate, since the values returned may be greater than the data types used by <code>cbCIn ()</code> and <code>CIn ()</code> can handle.</p> <p>**<code>cbCLoad ()</code>, <code>cbCLoad32 ()</code>, <code>CLoad ()</code> and <code>CLoad32 ()</code> only accept <code>Count=0</code>. These functions are used to reset the counter.</p>
CounterNum:	1
Count	0 to 232-1 when reading the counter.
	<p>The “Basic signed integers” guidelines on page 140 apply when using <code>cbCIn ()</code> or <code>CIn ()</code> for values greater than 32767, and when using <code>cbCIn32 ()</code> or <code>CIn32 ()</code> for values greater than 2147483647.</p> <p>0 when loading the counter.</p> <p><code>cbCLoad ()</code> and <code>cbCLoad32 ()/CLoad ()</code> and <code>CLoad32 ()</code> are only used to reset the counter for this module to 0. No other values are valid.</p>
RegNum	LOADREG1

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the USB LED on a Measurement Computing USB module to blink.

When you have several modules connected to the computer, use these functions to identify a particular module by making its LED blink.

USB-SSR Series

The USB-SSR24 and USB-SSR08 support the following UL and UL for .NET features.

Digital I/O

Port I/O functions, methods, and argument values supported

UL:	<code>cbDOut()</code> , <code>cbDIn()</code>
UL for .NET:	<code>DOut()</code> , <code>DIn()</code>
PortNum	USB-SSR08: <code>FIRSTPORTCL</code> , <code>FIRSTPORTCH</code> USB-SSR24: <code>FIRSTPORTA</code> , <code>FIRSTPORTB</code> , <code>FIRSTPORTCL</code> , <code>FIRSTPORTCH</code>
DataValue	USB-SSR08: 0 to 15 for <code>FIRSTPORTCL</code> or <code>FIRSTPORTCH</code> USB-SSR24: 0 to 255 for <code>FIRSTPORTA</code> or <code>FIRSTPORTB</code> 0 to 15 for <code>FIRSTPORTCL</code> or <code>FIRSTPORTCH</code>

Bit I/O functions, methods, and argument values supported

UL:	<code>cbDBitIn()</code> , <code>cbDBitOut()</code>
UL for .NET:	<code>DBitIn()</code> , <code>DBitOut()</code>
PortType	<code>FIRSTPORTA</code>
BitNum	USB-SSR08: 16 to 23 on <code>FIRSTPORTA</code> USB-SSR24: 0 to 23 on <code>FIRSTPORTA</code>

Miscellaneous

Miscellaneous functions and methods supported

UL:	<code>cbFlashLED()</code>
UL for .NET:	<code>FlashLED()</code>

Causes the USB LED on a Measurement Computing USB module to blink.

When you have several modules connected to the computer, use these functions to identify a particular module by making its LED blink.

Hardware considerations

Do not change state of switches while program is running

Do not change the state of any switches (labeled S1, S2, and S3) on a USB-SSR module while a program is running. UL stores the current state of each switch, and changing a switch setting while a program is running can cause unpredictable results.

Switch & Sense 8/8

The Switch & Sense 8/8 supports the following UL and UL for .NET features.

Digital I/O

Port I/O functions, methods, and argument values supported

UL:	<code>cbDOut()</code> , <code>cbDIn()</code>
UL for .NET:	<code>DOut()</code> , <code>DIn()</code>
PortNum	AUXPORT
DataValue	0 to 255 for AUXPORT

Bit I/O functions, methods, and argument values supported

UL:	<code>cbDBitIn()</code> , <code>cbDBitOut()</code>
UL for .NET:	<code>DBitIn()</code> , <code>DBitOut()</code>
PortType	AUXPORT
BitNum	0 to 7 on AUXPORT

Miscellaneous

Miscellaneous functions and methods supported

UL:	<code>cbFlashLED()</code>
UL for .NET:	<code>FlashLED()</code>

Causes the USB LED on a Measurement Computing USB module to blink.

When you have several modules connected to the computer, use these functions to identify a particular module by making its LED blink.

DEMO-BOARD

The **DEMO-BOARD** is a software simulation of a data acquisition board that simulates analog input and digital I/O operations.

Analog Input

Analog input functions and methods supported

UL: `cbAIn()`, `cbAInScan()`, `cbATrig()`, `cbFileAInScan()`

UL for .NET: `AIn()`, `AInScan()`, `ATrig()`, `FileAInScan()`

Analog input argument values

Options `BACKGROUND`, `CONTINUOUS`, `SINGLEIO`, `DMAIO`

HighChan 7 max

Rate 300000

Digital I/O

Digital I/O functions and methods supported

UL: `cbDIn()`, `cbDBitIn()`, `cbDInScan()`, `cbDOut()`, `cbDBitOut()`, `cbDOutScan()`, `cbDConfigPort()`

UL for .NET: `DIn()`, `DBitIn()`, `DInScan()`, `DOut()`, `DBitOut()`, `DOutScan()`, `DConfigPort()`

Digital I/O argument values

PortNum `FIRSTPORTA`, `FIRSTPORTB`, `AUXPORT`

DataValue 0 to 255 using `FIRSTPORTA`, `FIRSTPORTB`, or `AUXPORT`

BitNum 0 to 15 using `FIRSTPORTA`
0 to 7 using `AUXPORT`

Using the Demo-Board

Analog input

The **DEMO-BOARD** simulates eight channels of 16-bit analog input. *InstaCal* is used to configure the following waveforms on the analog input channels:

- sine wave
- square wave
- saw-tooth, ramp
- damped sine wave
- input from a data file

The data file is a streamer file, so any data that has been previously saved in a streamer file can be used as a source of demo data by the board. Data files are named `DEMO0.DAT` through `DEMO7.DAT`. When a data file is assigned to a channel, the library tries to extract data for that channel from the streamer file. If data for that channel does not exist, then the first (and possibly only) channel data in the streamer is extracted and used.

For example, `DEMO2.DAT` is assigned as the data source for channel 5 on the `DEMO_BOARD`. The library will try to extract data from the file that corresponds to channel 5. If `DEMO2.DAT` has scan data that corresponds to channels 0 through 15, then channel 5 data is extracted. If `DEMO2.DAT` only has data for a single channel, the data for that channel is used as the data source for channel 5.

Digital I/O

The **DEMO-BOARD** simulates the following:

- One eight-bit `AUXPORT` configurable digital input/output port. Each bit of the `AUXPORT` generates a square wave with a different period.
- Two eight-bit configurable digital I/O ports—`FIRSTPORTA`, `FIRSTPORTB`—which can be used for high speed scanning. `FIRSTPORTA` functions like `AUXPORT` in that it generates square waves. Each bit of `FIRSTPORTB` generates a pulse with a different frequency.

Digital Input Boards

Introduction

This section provides details on using digital input boards in conjunction with the Universal Library. Boards released after the printing of this document will be described in Readme files on the Universal Library disk.

To fully understand and maximize the performance of this and other digital input function calls, refer to the 82C55 data sheet in the *Documents* subdirectory of the installation (C:\Program files\Measurement Computing\DAQ\Documents by default), or from our web site at www.mccdaq.com/PDFmanuals/82C55A.pdf. Refer also to the 8536 data sheet (this data sheet file is not available in PDF format).

CIO- and PC104- DI Series

Digital I/O

Digital input functions and methods supported

UL: `cbDIn, cbDBitIn()`

UL for .NET: `DIn, DBitIn()`

Digital input argument values

PortNum `FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL and FIRSTPORTCH.`

For **DI48, DI96, and DI192**, the following argument values are also valid:
`SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH`

For **DI96, and DI192**, the following argument values are also valid:
`THIRDPORATA, THIRDPORATB, THIRDPORATCL, THIRDPORATCH, FOURTHPORATA,`
`FOURTHPORATB, FOURTHPORATCL, FOURTHPORATCH`

For **DI192**, the following argument value is also valid:
`FIFTHPORATA through EIGHTHPORATCH`

DataValue 0 to 255 for PORTA or PORTB,
 0 to 15 for PORTCL or PORTCH

BitNum 0 to 23 for FIRSTPORTA

For **DI48, DI96, and DI192**, the following argument values are also valid:
 24 to 47 using `FIRSTPORTA`

For **DI96, and DI192**, the following argument values are also valid:
 48 to 95 using `FIRSTPORTA`

For **DI192**, the following argument values are also valid:
 96 to 191

CIO-DISO48

Digital I/O

Digital input functions and methods supported

UL: `cbDIn, cbDBitIn()`

UL for .NET: `DIn, DBitIn()`

Digital input argument values

PortNum `FIRSTPORTA, SECONDPORTA, THIRDPORTA, FOURTHPORTA, FIFTHPORTA, SIXTHPORTA`

DataValue `0 to 255`

BitNum `0 to 47 using FIRSTPORTA`

Digital Output Boards

Introduction

This chapter provides details on using digital output boards in conjunction with the Universal Library. Boards released after the printing of this document will be described in Readme files on the Universal Library disk.

To fully understand and maximize the performance of this and other digital input function calls, refer to the 82C55 data sheet in the *Documents* subdirectory of the installation (C:\Program files\Measurement Computing\DAQ\Documents by default), or from our web site at www.mccdaq.com/PDFmanuals/82C55A.pdf. Refer also to the 8536 data sheet (this data sheet file is not available in PDF format).

CIO-RELAY Series

Digital I/O

Digital output functions and methods supported

UL: `cbDOut, cbDBitOut()`

UL for .NET: `DOut, DBitOut()`

Digital output argument values

PortNum `FIRSTPORTA`

For **CIO-RELAY16 & 16/M**, the following argument values are also valid:
`FIRSTPORTB`

For **CIO-RELAY24**, the following argument values are also valid:
`SECONDPORTA`

For **CIO-RELAY32**, the following argument values are also valid:
`SECONDPORTB`

DataValue 0 to 255

BitNum 0 to 7 using `FIRSTPORTA`

For **CIO-RELAY16 & 16/M**, the following argument values are also valid:
0 to 15 using `FIRSTPORTA`

For **CIO-RELAY24**, the following argument values are also valid:
0 to 23 using `FIRSTPORTA`

For **CIO-RELAY32**, the following argument values are also valid:
0 to 31 using `FIRSTPORTA`

USB-ERB Series

The USB-ERB08 and USB-ERB24 support the following UL and UL for .NET features.

Digital I/O

Port I/O functions, methods, and argument values supported

UL:	<code>cbDOut()</code> , <code>cbDIn()</code>
UL for .NET:	<code>DOut()</code> , <code>DIn()</code>
PortNum	USB-ERB08: <code>FIRSTPORTCL</code> , <code>FIRSTPORTCH</code> USB-ERB24: <code>FIRSTPORTA</code> , <code>FIRSTPORTB</code> , <code>FIRSTPORTCL</code> , <code>FIRSTPORTCH</code>
DataValue	USB-ERB08: 0 to 15 for <code>FIRSTPORTCL</code> or <code>FIRSTPORTCH</code> USB-ERB24: 0 to 255 for <code>FIRSTPORTA</code> or <code>FIRSTPORTB</code> 0 to 15 for <code>FIRSTPORTCL</code> or <code>FIRSTPORTCH</code>

Bit I/O functions, methods, and argument values supported

UL:	<code>cbDBitIn()</code> , <code>cbDBitOut()</code>
UL for .NET:	<code>DBitIn()</code> , <code>DBitOut()</code>
PortType	<code>FIRSTPORTA</code>
BitNum	USB-ERB08: 16 to 23 on <code>FIRSTPORTA</code> USB-ERB24: 0 to 23 on <code>FIRSTPORTA</code>

Miscellaneous

Miscellaneous functions and methods supported

UL:	<code>cbFlashLED()</code>
UL for .NET:	<code>FlashLED()</code>

Causes the USB LED on a Measurement Computing USB module to blink.

When you have several modules connected to the computer, use these functions to identify a particular module by making its LED blink.

Do not change state of invert/non-invert switch (S1) while program is running

Do not change the state of the invert/non-invert switch (labeled S1) on a USB-ERB module while a program is running. UL stores the current state of this switch, and changing the switch setting while a program is running can cause unpredictable results.

CIO- and PC104-DO Series

Digital I/O

Digital output functions and methods supported

UL: `cbDOut, cbDBitOut()`

UL for .NET: `DOut, DBitOut()`

Digital output argument values

PortNum `FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL and FIRSTPORTCH.`

For **DO48H, DO48DD, DO96H** and **DO192H**, the following argument values are also valid:

`SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH`

For **DO96H** and **DO192H**, the following argument values are also valid:

`THIRDPORTA, THIRDPORTB, THIRDPORTCL, THIRDPORTCH, FOURTHPORTA, FOURTHPORTB, FOURTHPORTCL, FOURTHPORTCH`

For **DO192H**, the following argument values are also valid:

`FIFTHPORTA through EIGHTHPORTCH`

DataValue 0 to 255 for `PORTA` or `PORTB`,
0 to 15 for `PORTCL` or `PORTCH`

BitNum 0 to 23 for `FIRSTPORTA`

For **DO48H, DO48DD, DO96H** and **DO192H** the following argument values are also valid:

24 to 47 using `FIRSTPORTA`

For **DO96H** and **DO192H**, the following argument values are also valid:

48 to 95 using `FIRSTPORTA`

For **DO192H**, the following argument values are also valid:

96 to 191

Counter Boards

Introduction

This chapter provides details on using counter/timer boards in conjunction with the Universal Library. Boards released after the printing of this user's guide are explained in Readme files on the Universal Library installation disk.

Visual Basic signed integers

When reading or writing ports that are 16-bits wide, be aware of the following issue using signed integers (which is required when using Visual Basic):

On some boards, such as the **CIO-CTR10** count register or **AUXPORT** digital ports, the ports are 16-bits wide. When accessing the data at these ports, the digital values are arranged as a single 16-bit word. Using signed integers, values above 0111 1111 1111 1111 (32767 decimal) can be confusing. The next increment, 1000 0000 0000 0000 has a decimal value of -32768. Using signed integers, this is the value that is returned from a 16-bit counter at half of maximum count. The value for full count (just before the counter turns over) is -1. Keep this in mind if you are using Visual Basic, since Visual Basic does not supply unsigned integers (values from 0 to 65535) or unsigned longs (values from 0 to 4,294,967,295). Refer to "[16-bit values using a signed integer data type](#)" on page 16 for more information.

The Universal Library provides functions for the initialization and configuration of counter chips, and can configure a counter for any of the counter operations. However, counter configuration does not include counter-use, such as event counting and pulse width. Counter-use is accomplished by programs which use the counter functions. The Universal Library provides the `cbCFreqIn()` function for counter use, while the Universal Library for .NET provides the `CFreqIn()` method. Other functions and methods may be added for counter use to later revisions.

Read the counter chip's data sheet

To use a counter for any but the simplest counting function, you must read, understand, and employ the information contained in the chip manufacturer's data sheet. Technical support of the Universal Library does not include providing, interpreting, or explaining the counter chip data sheet.

To fully understand and maximize the performance of the counter/timer boards and their related function calls, review the following related data sheet(s):

Counter/Timer	Data Sheet
82C54	82C54.pdf is located in the Documents installation subdirectory, and is also available from our web site at www.mccdaq.com/PDFmanuals/82C54.pdf .
AM9513	9513A.pdf is located in the Documents installation subdirectory, and is also available from our web site at www.mccdaq.com/PDFmanuals/9513A.pdf .
Z8536	The data book for the Z8536 counter chip is included with the product that employs this chip.
LS7266	LS7266R1.pdf is located in the Documents installation subdirectory, and is also available from our web site at www.mccdaq.com/PDFmanuals/ls7266r1.pdf .

Counter chip variables

UL counter initialization and configuration functions include names for bit patterns, such as **ALEGATE**, which stands for Active Low Enabled Gate N. In any case where the UL has a name for a bit pattern, it is allowed to substitute the bit pattern as a numeric. This will work, but your programs will be harder to read and debug.

CTR Series

Counter I/O

Counter functions and methods supported

UL:	<code>cbC9513Config()</code> , <code>cbC9513Init()</code> , <code>cbCStoreOnInt()</code> , <code>cbCFreqIn()</code> , <code>cbCIn()</code> , <code>cbCLoad()</code>
UL for .NET:	<code>C9513Config()</code> , <code>C9513Init()</code> , <code>CStoreOnInt()</code> , <code>CFreqIn()</code> , <code>CIn()</code> , <code>CLoad()</code>

Counter argument values

CounterNum	1 to 5 (All boards in this series) CTR10 & CTR10HD also support counters 6 through 10 CTR20HD also supports counters 11 through 20
RegNum	<code>LOADREG1 - 5</code> , <code>HOLDREG1 - 5</code> , <code>ALARM1CHIP1</code> , <code>ALARM2CHIP1</code> CTR10 & CTR10HD also support <code>LOADREG6 - 10</code> , <code>HOLDREG6 - 10</code> , <code>ALARM1CHIP2</code> , <code>ALARM2CHIP2</code> CTR20HD also supports <code>LOADREG11 - 20</code> , <code>HOLDREG11 - 20</code> , <code>ALARM1CHIP3</code> , <code>ALARM2CHIP3</code> , <code>ALARM1CHIP4</code> , <code>ALARM2CHIP4</code>
LoadValue	0 to 65535 (Refer to " 16-bit values using a signed integer data type " on page 16 for information on 16-bit values using unsigned integers.)
ChipNum	1 (All boards in this series) CTR10 & CTR10HD also support chip 2 CTR20HD also support chips 3 and 4
FOutSource	<code>CTRINPUT1 - 5</code> , <code>GATE1 - 5</code> , <code>FREQ1 - 5</code> These values refer to the sources on a particular 9513 chip, so are limited to the sources on that particular chip. For example, to set the source to the input for counter 6, use <code>CTRINPUT1</code> (the first counter on the second 9513 chip).
CountSource	<code>TCPREVCTR</code> , <code>CTRINPUT1 - 5</code> , <code>GATE1 - 5</code> , <code>FREQ1 - 5</code> These values refer to the sources on a particular 9513 chip, so are limited to the sources on that particular chip. For example, to set the source to the input for counter 6, use <code>CTRINPUT1</code> (the first counter on the second 9513 chip). Likewise for the <code>TCPREVCTR</code> value; when applied to the first counter on a chip (counter 6, for example) the "previous counter" is counter 5 on that chip (for this example, counter 10).

Digital I/O

Digital I/O functions and methods supported

UL:	<code>cbDOut()</code> , <code>cbDIn()</code> , <code>cbDBitIn()</code> , <code>cbDBitOut()</code>
UL for .NET:	<code>DOut()</code> , <code>DIn()</code> , <code>DBitIn()</code> , <code>DBitOut()</code>

Digital I/O argument values

PortNum	<code>AUXPORT*</code>
DataValue	CTR05: 0 to 255 CTR10: 0 to 65535. Refer to " Basic signed integers " on page 164.
BitNum	CTR05: 0 to 7; CTR10: 0 to 15 * <code>AUXPORT</code> is not configurable for these boards.

Event notification

Event notification functions and methods supported

PCI-CTR05, PCI-CTR10 and PCI-CTR20HD only

UL: `cbEnableEvent()`, `cbDisableEvent()`

UL for .NET: `EnableEvent()`, `DisableEvent()`

Event notification argument values

EventType `ON_EXTERNAL_INTERRUPT` (UL)/`OnExternalInterrupt` (UL for .NET)

Hardware considerations

Clock input frequency (PCI boards only)

The clock source for each of the four counters is configurable with *InstaCal*:

PCI-CTR05, PCI-CTR10: 1 MHz, 1.67 MHz, 3.33 MHz, 5 MHz

PCI-CTR20HD: 1 MHz, 1.67 MHz, 3.33 MHz, 5 MHz, or External

Event Notification

`ON_EXTERNAL_INTERRUPT` cannot be used with `cbCStoreOnInt()` or `CStoreOnInt()`.

CTR Series boards that support event notification only support external rising edge interrupts.

INT32 Series

Counter I/O

Counter functions and methods supported

UL: `cbC8536Config()`, `cbC8536Init()`, `cbCIn()`, `cbCLoad()`

UL for .NET: `C8536Config()`, `C8536Init()`, `CIn()`, `CLoad()`

Counter argument values

CounterNum 1 to 6

ChipNum 1 or 2

RegName LOADREG1 through LOADREG6

LoadValue Values up to 65,535 ($2^{16}-1$) can be used. Refer to "[Basic signed integers](#)" on page 164 for more information.

Digital I/O

Digital I/O functions and methods supported

UL: `cbDIn()`, `cbDOut()`, `cbDBitIn()`, `cbDBitOut()`, `cbDConfigPort()`

UL for .NET: `DIn()`, `DOut()`, `DBitIn()`, `DBitOut()`, `DConfigPort()`

Digital I/O argument values

PortNum FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, SECONDPORTA, SECONDPORTB and SECONDPORTCL.

DataValue 0 to 255 using PORTA or PORTB
0 to 15 using PORTCL

BitNum 0 to 39 using FIRSTPORTA

Hardware considerations

Argument Value vs. configuration

These boards have two 8536 chips, which have both counter and digital I/O and interrupt vectoring capabilities. The numbers stated for digital I/O apply when both chips are configured for the maximum number of digital devices. The numbers stated for counter I/O apply when both chips are configured for the maximum number of counter devices.

PPIO-CTR06

Counter I/O

Counter functions and methods supported

UL: `cbC8254Config()`, `cbCIn()`, `cbCLoad()`

UL for .NET: `C8254Config()`, `CIn()`, `CLoad()`

Counter argument values

CounterNum 1 to 6

Digital I/O

Digital I/O functions and methods supported

UL: `cbDIn()`, `cbDOut()`, `cbDBitIn()`, `cbDBitOut()`

UL for .NET: `DIn()`, `DOut()`, `DBitIn()`, `DBitOut()`

Digital I/O argument values

PortNum AUXPORT*

DataValue 0 to 15, or 0 to 255, depending on jumper setting

BitNum 0 to 3, or 0 to 7, depending on jumper setting

* AUXPORT is not configurable for this board.

QUAD Series

Counter I/O

Counter functions and methods supported

UL: `cbC7266Config()`, `cbCIn()`, `cbCIn32()`, `cbCLoad()`, `cbCLoad32()`, `cbCStatus()`

UL for .NET: `C7266Config()`, `CIn()`, `CIn32()`, `CLoad()`, `CLoad32()`, `CStatus()`

Counter argument values

CounterNum	PCM-QUAD02, CIO-QUAD02 1 to 2 CIO-QUAD04, PCI-QUAD04 1 to 4
RegName	UL: COUNT1, COUNT2, PRESET1, PRESET2, PRESCALER1, PRESCALER2 UL for .NET: QuadCount1, QuadCount2, QuadPreset1, QuadPreset2, QuadPreScaler1, QuadPreScaler2 CIO-QUAD04, PCI-QUAD04 also support: UL: COUNT3, COUNT4, PRESET3, PRESET4, PRESCALER3, PRESCALER4 UL for .NET: QuadCount3, QuadCount4, QuadPreset3, QuadPreset4, QuadPreScaler3, QuadPreScaler4
LoadValue	When using <code>cbCLoad32()</code> or <code>CLoad32()</code> to load the COUNT# or PRESET# registers, values up to 16.78 million ($2^{24}-1$) can be loaded. Values using <code>cbCLoad()</code> and <code>CLoad()</code> are limited to 65,535 ($2^{16}-1$). Refer to " Basic signed integers " on page 164 for more information. When loading the PRESCALER# register, values can be from 0 to 255. (Digital Filter Clock frequency = 10 MHz/LoadValue + 1.)

Hardware considerations

Loading and Reading 24-bit values

The **QUAD** series boards feature a 24-bit counter. For counts of less than 16-bits (65535), you can use the `cbCIn()` and `cbCLoad()` functions, or the `CIn()` and `CLoad()` methods. You can use the `cbCIn32()` and `cbCLoad()` functions, or the `CIn32()` and `CLoad32()` methods for any number supported by the LS7266 counter (24 bits = 16777216).

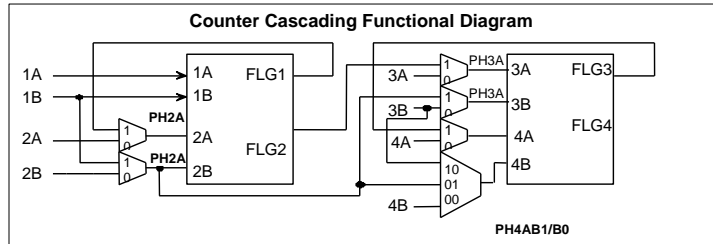
Cascading counters (PCI-QUAD04 only)

The **PCI-QUAD04** can be set up for cascading counters. By setting the appropriate registers, you can have (4) 24-bit counters, (2) 48-bit counters, (1) 24-bit and (1) 72-bit counters, or (1) 96-bit counter. The OUTPUT pins of a counter are directed to the next counter by setting the FLG1 to CARRY/BORROW and the FLG2 to UP/DOWN. Bits 3 and 4 of the IOR Register control are set to 1,0 to accomplish this.

You can set these bits by using the functions `cbC7266Config(BoardNum, CounterNum, Quadrature, CountingMode, DataEncoding, IndexMode, InvertIndex, FlagPins, and GateEnable)`. When using the Universal Library for .NET, use the `C7266Config()` method.

The constant `CARRYBORROW_UPDOWN` (value of 3) is used for the parameter `FlagPins`.

The IOR register cannot be read. However, you can read the values of the BADR2+9 register. The value for Base 2 can be determined by looking at the resources used by the board. The 8-bit region is BADR2. The BADR+9 register contains values for PhxA and PhxB, for $x = 1$ to 4 to identify counters. The diagram below indicates the routing of the FLG pins depending on the value of PhxA and PhxB. The actual values of the BADR2+9 register are shown below:



Register BADR2 + 9 D0-D6

	PH2A	PH2B	PH3A	PH3B	PH4A	PH4B1/PH4B0	Value
Case 1: (4) 24-bit counters (1/2/3/4)	0	0	0	0	0	0,0	00
Case 2: (2) 48-bit counters (1-2/3/4)	1	1	0	0	1	1,0	53
Case 3: (1) 24-bit, (1) 72-bit (1/2-3-4)	0	0	1	1	1	0,1	3C
Case 4: (1) 96-bit counter (1-2-3-4)	1	1	1	1	1	0,1	3F

Defaults to 0x00 (no inter-counter connections).

Examples

Case 1: (4) 24-bit counters (1/2/3/4)

```
cbC7266Config(0,1,0,0,2,0,0,1,0)
cbC7266Config(0,2,0,0,2,0,0,1,0)
cbC7266Config(0,3,0,0,2,0,0,1,0)
cbC7266Config(0,4,0,0,2,0,0,1,0)
```

Case 2: (2) 48-bit counters (1-2/3-4)

```
cbC7266Config(0,1,0,0,2,0,0,3,0)
cbC7266Config(0,2,0,0,2,0,0,1,0)
cbC7266Config(0,3,0,0,2,0,0,3,0)
cbC7266Config(0,4,0,0,2,0,0,1,0)
```

Case 3: (1) 24-bit & (1) 72-bit counter (1/2-3-4)

```
cbC7266Config(0,1,0,0,2,0,0,1,0)
cbC7266Config(0,2,0,0,2,0,0,3,0)
cbC7266Config(0,3,0,0,2,0,0,3,0)
cbC7266Config(0,4,0,0,2,0,0,1,0)
```

Case 4: (1) 96-bit counter (1-2-3-4)

```
cbC7266Config(0,1,0,0,2,0,0,3,0)
cbC7266Config(0,2,0,0,2,0,0,3,0)
cbC7266Config(0,3,0,0,2,0,0,3,0)
cbC7266Config(0,4,0,0,2,0,0,1,0)
```

The actual value of the BADR+9 register is not set until the `cbCLoad()/CLoad()` command is called.

Counter4 setting

Setting Counter4 to CARRYBORROW-UPDOWN is NOT VALID.

USB-4300 Series

The USB-4300 Series includes the USB-4301, USB-4302, USB-4303, and USB-4304 devices.

Counter I/O

Counter functions and methods supported

UL:	<code>cbC9513Config()</code> , <code>cbC9513Init()</code> , <code>cbCStoreOnInt()</code> , <code>cbCFreqIn()</code> , <code>cbCIn32()</code> , <code>cbCIn()</code> , <code>cbCLoad32()</code> , <code>cbCLoad()</code>
UL for .NET:	<code>C9513Config()</code> , <code>C9513Init()</code> , <code>CStoreOnInt()</code> , <code>CFreqIn()</code> , <code>CIn32()</code> , <code>CIn()</code> , <code>Cload32()</code> , <code>CLoad()</code>

Counter argument values

CounterNum	USB-4301 and USB-4302: 1 through 5 USB-4303 and USB-4304: 1 through 5, and 6 through 10
RegNum	USB-4301 and USB-4302: <code>LOADREG1</code> - 5, <code>HOLDREG1</code> - 5, <code>ALARM1CHIP1</code> , <code>ALARM2CHIP1</code> USB-4303 and USB-4304: <code>LOADREG1</code> - 10, <code>HOLDREG1</code> - 10, <code>ALARM1CHIP1</code> , <code>ALARM2CHIP1</code> , <code>ALARM1CHIP2</code> , <code>ALARM2CHIP2</code>
LoadValue	0 to 65535 (Refer to " 16-bit values using a signed integer data type " on page 16 for information on 16-bit values using unsigned integers.)
ChipNum	USB-4301: 1 USB-4302: 1 USB-4303: 1, 2 USB-4304: 1, 2
FOutSource	<code>CTRINPUT1</code> - 5, <code>GATE1</code> - 5, <code>FREQ1</code> - 5 These values refer to the sources on a particular 9513 chip, so are limited to the sources on that particular chip. For example, to set the source to the input for counter 6, use <code>CTRINPUT1</code> (the first counter on the second 9513 chip).
CountSource	<code>TCPREVCTR</code> , <code>CTRINPUT1</code> - 5, <code>GATE1</code> - 5, <code>FREQ1</code> - 5 These values refer to the sources on a particular 9513 chip, so are limited to the sources on that particular chip. For example, to set the source to the input for counter 6, use <code>CTRINPUT1</code> (the first counter on the second 9513 chip). Likewise for the <code>TCPREVCTR</code> value: when applied to the first counter on a chip (for counter 6, the "previous counter" is counter 5 on that chip (for this example, counter 10).

Digital I/O

Port I/O functions and methods supported

UL:	<code>cbDIn()</code> , <code>cbDOut()</code>
UL for .NET:	<code>DIn()</code> , <code>DOut()</code>
PortNum	<code>AUXPORT*</code>
DataValue	0 to 255 * <code>AUXPORT</code> is not configurable for these boards.

Bit I/O functions and methods supported

UL:	<code>cbDBitIn()</code> , <code>cbDBitOut()</code>
UL for .NET:	<code>DBitIn()</code> , <code>DBitOut()</code>

PortType	AUXPORT*
BitNum	0 to 7

* AUXPORT is not configurable for these boards.

Event notification

Event notification functions and methods supported

UL:	cbEnableEvent(), cbDisableEvent()
UL for .NET:	EnableEvent(), DisableEvent()

Event notification argument values

EventType	ON_EXTERNAL_INTERRUPT
EventParameter	LATCH_DI, LATCH_DO

LATCH_DI can only be used with cbDIn() and cbDBitIn(). LATCH_DO can only be used with cbDOut() and cbDBitOut().

Hardware considerations

Clock input frequency

The clock speed is configurable with *InstaCal* for 1 MHz, 1.67 MHz, 3.33 MHz, or 5 MHz.

Event Notification

ON_EXTERNAL_INTERRUPT can't be used with cbCStoreOnInt() or CStoreOnInt().

Interrupt Input pin

You can configure the interrupt input pin (**INT**) with *InstaCal* to trigger off rising or falling edge inputs. You can program this pin to perform the following tasks:

- Send an event notification to the computer. The transfer rate is system-dependent.
- Latch digital input data.
- Latch digital output data.
- Save the current value of a counter. You can configure this option for each counter individually.

Digital bit latching

Digital input bit latching is supported by cbDIn() and cbDBitIn(). Digital output bit latching is supported by cbDOut() and cbDBitOut().

- Use the EventParam option LATCH_DI with cbDIn() and cbDBitIn() to return the data that was latched in at the most recent interrupt edge. The current value of the digital inputs (0 or 1) is read and stored. The stored value is updated when an active edge occurs on the Interrupt Input pin.
There is a latency period between when an active interrupt edge occurs on the INT pin and when the action triggered by that interrupt occurs. This latency can be as long as 100 µs, but typically varies from about 9 µs to about 40 µs between interrupts.
- Use the EventParam option LATCH_DO with cbDOut() and cbDBitOut() to latch out the data most recently written to the device. The digital outputs are not set to the value written until an active edge occurs on the Interrupt Input pin.

Expansion Boards

Introduction

This chapter provides details on using expansion (**EXP**) boards in conjunction with the Universal Library. Boards released after the printing of this user's guide are described in Readme files on the Universal Library disk.

Auto-detected expansion boards are automatically added to the *InstaCal* configuration when *InstaCal* is launched. The device properties are automatically adjusted to reflect the expansion properties. These types of expansion boards are not shown as a separate device in the device tree.

Manually configured expansion boards, such as the CIO-EXP series, are added to the *InstaCal* configuration by selecting the compatible board on the main **InstaCal** form, and selecting the **Add Exp Board...** option from the **Install** menu. The expansion board will then be shown in the device tree as a branch attached to the device it was added to.

AI-EXP48

The AI-EXP48 expansion board can be used in combination with compatible parent boards, such as a USB-1616HS Series board.

The AI-EXP48 supports all of the analog input and temperature input capabilities of the parent board, but expands the channel count as follows:

Analog Input

Analog input argument values

HighChan 16 to 63 in single-ended mode, 8 to 31 in differential mode

Temperature Input

Temperature input argument values

HighChan 8 to 31

DAQ input

DAQ input argument values

ChanArray ANALOG: 0 to 63 in single-ended mode, 0 to 31 in differential mode

 CJC: 6 to 11

 TC: 8 to 31

Hardware considerations

Associating CJC channels with TC channels

The TC channels must immediately follow their associated CJC channels in the channel array. For accurate thermocouple readings, associate CJC channels with the TC channels as listed in the following table:

CJC channels	TC channels
CJC6	TC8 through TC11
CJC7	TC12 through TC15
CJC8	TC16 through TC19
CJC9	TC20 through TC23
CJC10	TC24 through TC27
CJC11	TC28 through TC31

The parent board must be configured for differential inputs when using thermocouples

TC inputs are supported by differential mode configuration only.

CIO-EXP Series

Temperature Input

Temperature input functions and methods supported

UL: `cbTIn()`, `cbTInScan()`

UL for .NET: `TIn()`, `TInScan()`

Temperature input argument values

Options `NOFILTER`

Scale `CELSIUS`, `FAHRENHEIT`, `KELVIN`

HighChan From 16 up to 255 for 16-channel boards, and from 64 up to 303 for 64-channel boards. The value depends on the number of boards connected and the application.

Hardware considerations

CIO-EXP boards are used only in combination with an A/D board. Channel numbers for accessing the expansion boards begin at 16 for 8-channel and 16-channel boards, and at 64 for 64-channel boards. To calculate the channel number for access to **CIO-EXP** channels, use the following formula:

$$\text{Chan} = (\text{ADChan} * 16) + (16 + \text{MuxChan})$$

`MuxChan` is a number ranging from 0 to 15 that specifies the channel number on a particular bank of the expansion board. An **EXP32** has two banks, so the channel numbers for one **EXP32** connected to an A/D board would range from 16 to 47.

If all A/D channels are not used for **CIO-EXP** output, direct input to the A/D board is still available at these channels (using channel numbers below 16).

When **CIO-EXP** boards are used for **temperature input**, set the gain of the A/D board to a specific range. When using A/D boards with programmable gain, the range is set by the Universal Library. However, when using boards with switch-selectable gains, you must set the gain to a range that is dependent on the temperature sensor in use. Generally, thermocouple measurements require the A/D board to be set to 5 V bipolar, if available (or 10 V bipolar if not). RTD sensors require a setting of 10 V unipolar, if available. These checks are made when you configure the system for temperature measurement using *InstaCal*.

MEGA-FIFO

Memory I/O

Memory I/O is only used in combination with a board which has DT-Connect.

Memory functions and methods supported

UL: `cbMemSetDTMode()`, `cbMemReset()`, `cbMemRead()`, `cbMemWrite()`,
 `cbMemReadPretrig()`

UL for .NET: `MemSetDTMode()`, `MemReset()`, `MemRead()`, `MemWrite()`, `MemReadPretrig()`

Some of these functions are integrated into the `cbAInScan()` function and `AInScan()` method. For example, if you use **MEGA-FIFO** with an A/D board and select the `EXTMEMORY` option, you would not have to call the `cbMemSetDTMode()` and `cbMemWrite` functions, or the `MemSetDTMode()` and `MemWrite()` methods.

EXTMEMORY option

Continuous mode can't be used with the `EXTMEMORY/ExtMemory` option.

MetraBus Boards

Introduction

This section provides details on using all **MetraBus** boards in conjunction with the Universal Library. Future releases will be described in Readme files on the Universal Library installation disk.

To use any **MetraBus** I/O board, a **MetraBus** interface board, such as the **ISA-MDB64**, **PCI-MDB64** or a **CPCI-MDB64**, is required for the Universal Library functions to operate correctly. The interface board and a **MetraBus** cable provide the interface between the PC bus (ISA-, PC104-, PCI-, or CPCI-) and the **MetraBus** I/O Boards.

The **MetraBus** system is made up of at least one controller board that communicates with real world interface boards via a data bus (ribbon cable). The implication is that there will always be two or more boards in the system.

MDB64 Series

This series makes up the controller portion of the **MetraBus** system. The Universal Library contains no function to communicate specifically with this board. The functions in the library are directed to the devices on the bus instead.

For example, if this board was installed in *InstaCal* as board 0, and an **MII-32** was installed as board 1, the communication would be directed to board 1. If you wanted to read digital bits from this configuration, use the `cbDBitIn()` function or the `DBitIn()` method. The value of the `BoardNum` argument would be 1.

MIO and MII Digital I/O

All **MetraBus** boards require a cable and an interface board (such as an **ISA-**, **PC104-**, or **PCI- MDB64**) to interface to the host computer system.

Digital In

MII-32 Only

Digital input functions and methods supported

UL: `cbDIn`, `cbDBitIn()`

UL for .NET: `DIn`, `DBitIn()`

Digital input argument values

`PortNum` `FIRSTPORTA`, `FIRSTPORTB`, `SECONDPORTA`, `SECONDPORTB`

`DataValue` 0 to 255 for `PORTA` or `PORTB`

`BitNum` 0 to 31 for `FIRSTPORTA`

Digital Out

MIO-32 Only

Digital output functions and methods supported

UL: `cbDOut`, `cbDBitOut()`, `cbDBitIn()`, `cbDIn()`

UL for .NET: `DOut`, `DBitOut()`, `DBitIn()`, `DIn()`

Digital output argument values

`PortNum` `FIRSTPORTA`, `FIRSTPORTB`, `SECONDPORTA`, `SECONDPORTB`

`DataValue` 0 to 255 for `PORTA` or `PORTB`

`BitNum` 0 to 31 for `FIRSTPORTA`

Functions/methods for reading back the MIO-32 output state

Although the **MIO-32** is a digital output-only board, the state of the outputs can be read back using the UL functions `cbDIn()` and `cbDBitIn()`, or the UL for .NET methods `DIn()` and `DBitIn()`.

MEM Series Relay

All **MetraBus** boards require a cable and an interface board (such as an **ISA-**, **PC104-**, or **PCI- MDB64**) to interface to the host computer system.

Digital I/O

Digital I/O functions and methods supported

UL: `cbDOut()`, `cbDIn()`, `cbDBitIn()`, `cbDBitOut()`

UL for .NET: `DOut()`, `DIn()`, `DBitIn()`, `DBitOut()`

Digital I/O argument values

PortNum `FIRSTPORTA`

For **MEM-32**, the following argument values are also valid:

`FIRSTPORTB`, `SECONDPORTA`, `SECONDPORTB`

DataValue 0 to 255 for `PORTA` or `PORTB`

BitNum 0 to 7 for `FIRSTPORTA`

For **MEM-32**, the following argument values are also valid:

0 to 31 for `FIRSTPORTA`

Functions/methods for reading back the MEM Series Relay output state

Although the **MEM Series Relay** is a digital output-only board, the state of the outputs can be read back using the UL functions `cbDIn()` and `cbDBitIn()`, or the UL for .NET methods `DIn()` and `DBitIn()`.

MSSR-24 SSR

All **MetraBus** boards require a cable and an interface board (such as an **ISA-**, **PC104-**, or **PCI- MDB64**) to interface to the host computer system.

Digital I/O

Digital I/O functions and methods supported

UL: `cbDIn, cbDBitIn(), cbDOut, cbDBitOut()`

UL for .NET: `DIn, DBitIn(), DOut, DBitOut()`

Digital I/O argument values

PortNum `FIRSTPORTA, FIRSTPORTB, SECONDPORTA`

DataValue `0 to 255`

BitNum `0 to 24 using FIRSTPORTA`

Temperature Input Boards

Introduction

This chapter provides details on using temperature input boards in conjunction with the Universal Library and Universal Library for .NET. Boards released after the printing of this user's guide will be described in Readme files on the Universal Library disk.

For information on the CIO-EXP board series, refer to on page 174.

CIO-DAS-TEMP

Temperature input

Temperature input functions and methods supported

UL: `cbTIn()`, `cbTInScan()`

UL for .NET: `TIn()`, `TInScan()`

Temperature input argument values

Options `NOFILTER`

Scale `CELSIUS`, `FAHRENHEIT`, `KELVIN`

HighChan 0 to 31

Hardware considerations

Pacing Input

The rate of measurement is fixed at approximately 25 samples per second.

Selecting Thermocouples

J, K, E, T, R, S or B type thermocouples may be selected using *InstaCal*.

DAS-TC Series

Temperature Input

Temperature input functions and methods supported

UL: `cbTIn()`, `cbTInScan()`

UL for .NET: `TIn()`, `TInScan()`

Temperature input argument values

Options `NOFILTER`

Scale `CELSIUS`, `FAHRENHEIT`, `KELVIN`

HighChan `0 to 15`

Hardware considerations

Pacing input

The rate of measurement is fixed at approximately 25 samples per second.

Selecting thermocouples

J, K, E, T, R, S, N, or B type thermocouples may be selected using *InstaCal*.

Open thermocouples

When using `cbTInScan()` or `TInScan()` with the **DAS-TC**, an open thermocouple error (`OPENCONNECTION`) on any of the channels will cause all data to be returned as `-9999.0`. This is a hardware limitation. If your application requires isolating channels with defective thermocouples attached and returning valid data for the remainder of the channels, use the `cbTIn()` function or `TIn()` method instead.

To read the voltage input of the thermocouple, select `VOLTS` for the `Scale` parameter in `cbTIn()` and `cbTInScan()`, or `TIn()` and `TInScan()`.

USB-TEMP Series, USB-TC Series

The USB-TEMP Series includes the USB-TEMP and USB-TEMP-AI devices. The USB-TC Series includes the USB-TC and USB-TC-AI devices.

Each series supports the following UL and UL for .NET features:

Temperature input

Temperature input functions and methods supported

UL:	<code>cbTIn()</code> , <code>cbTInScan()</code>
UL for .NET:	<code>TIn()</code> , <code>TInScan()</code>

Temperature input argument values

Options	N/A
Scale	CELSIUS, FAHRENHEIT, KELVIN
HighChan	USB-TEMP and USB-TC: 0 to 7 USB-TEMP-AI and USB-TC-AI: 0 to 3

Voltage input (USB-TEMP-AI, USB-TC-AI)

Voltage input functions and methods supported

UL:	<code>cbVIn()</code>
UL for .NET:	<code>VIn()</code>

Voltage input argument values

Options	N/A
HighChan	0 to 3
Range	This board uses the Range set in <i>InstaCal</i> , so the Range argument to this function is ignored.

Digital I/O

Configuration functions, methods, and argument values supported

UL:	<code>cbDConfigBit()</code> , <code>cbDConfigPort()</code>
UL for .NET:	<code>DConfigBit()</code> , <code>DConfigPort()</code>
PortNum	AUXPORT
PortType	AUXPORT

Port I/O functions, methods, and argument values supported

UL:	<code>cbDIn()</code> , <code>cbDOut()</code>
UL for .NET:	<code>DOut()</code> , <code>DIn()</code>
PortNum	AUXPORT
DataValue	0 to 255 on AUXPORT

Bit I/O functions, methods, and argument values supported

UL:	<code>cbDBitIn()</code> , <code>cbDBitOut()</code>
UL for .NET:	<code>DBitIn()</code> , <code>DBitOut()</code>
PortType	AUXPORT

BitNum 0 to 7 on AUXPORT

Counter I/O (USB-TEMP-AI, USB-TC-AI)

Counter I/O functions and methods supported

UL: `cbCIn () *`, `cbCIn32 ()`, `cbCLoad () **`, `cbCLoad32 () **`

UL for .NET: `CIn () *`, `CIn32 ()`, `CLoad () **`, `CLoad32 () **`

*Although `cbCIn ()` and `CIn ()` are valid for use with this counter, `cbCIn32 ()` or `CIn32 ()` may be more appropriate, since the values returned may be greater than the data types used by `cbCIn ()` and `CIn ()` can handle.

**`cbCLoad ()`, `cbCLoad32 ()`, `CLoad ()` and `CLoad32 ()` only accept `Count=0`. These functions are used to reset the counter.

Counter I/O argument values

CounterNum 1

Count $2^{32}-1$ when reading the counter.

0 when loading the counter.

`cbCLoad ()` and `cbCLoad32 ()` / `CLoad ()` and `CLoad32 ()` are only used to reset the counter for this board to 0. No other values are valid.

The “[Basic signed integers](#)” guidelines on page 140 apply when using `cbCIn ()` or `CIn ()` for values greater than 32767, and when using `cbCIn32 ()` or `CIn32 ()` for values greater than 2147483647.

RegNum LOADREG1

Hardware considerations

Pacing readings

The internal update rate for measurement is a fixed value for these devices. If the UL reads the device faster than the internal update rate, readings "repeat." For example, if using `cbTIn ()` in a loop to measure a rapidly changing temperature, readings do not change for several iterations of the loop, then "jump" when the update occurs internally.

Using single sensors with `cbTInScan()`

When using single sensors for RTD or thermistor sensors, you should ignore the data for channels that do not have sensors attached. It is best to use `cbTIn ()` for these configurations, since you can select which channels to read. If you use `cbTInScan ()`, however, data for all channels over the entire range of channels are returned. Since some channels are not populated in this configuration, you should filter out the data for channels without sensors.

Saving configuration settings

InstaCal allows you to save configuration settings to a file or load a configuration from a previously saved file.

- Each USB-TEMP and USB-TEMP-AI channel can be configured to measure temperature data collected by one of five categories of temperature sensors: thermistors, thermocouples, RTDs, semiconductors, and *Disabled*.
- Each USB-TC and USB-TC-AI channel can be configured to measure temperature data collected by one of eight types of thermocouples.
- Each USB-TEMP-AI and USB-TC-AI voltage input channel can be configured for single-ended or differential mode and for one of four ranges - ± 10 V, ± 5 V, ± 2.5 V, or ± 1.25 V.

Recommended warm-up time

Allow the device to warm-up for 30 minutes before taking measurements. This warm-up time minimizes thermal drift and achieves the specified rated accuracy of measurements.

For RTD or thermistor measurements, this warm-up time is also required to stabilize the internal current reference.

Calibration

Any time the sensor category is changed in the configuration, a calibration is automatically performed by *InstaCal*. If the device has not been warmed up when this occurs, you should re-calibrate after the specified warm-up time.

Error codes

- The UL returns -9999 when a value is out of range or an open connection is detected.
- The UL returns -9000 when the device is not ready. This usually occurs right after the device is powered up and calibration factors are being loaded.

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the USB LED on a Measurement Computing USB module to blink.

When you have several modules connected to the computer, use these functions to identify a particular module by making its LED blink.

USB-5203, USB-5201

The USB-5203 and USB-5201 support the following UL and UL for .NET features.

Temperature input

Temperature input functions and methods supported

UL:	<code>cbTIn()</code> , <code>cbTInScan()</code>
UL for .NET:	<code>TIn()</code> , <code>TInScan()</code>

Temperature input argument values

Options	N/A
Scale	CELSIUS, FAHRENHEIT, KELVIN
HighChan	0 to 7

Digital I/O

Configuration functions, methods, and argument values supported

UL:	<code>cbDConfigBit()</code> , <code>cbDConfigPort()</code>
UL for .NET:	<code>DConfigBit()</code> , <code>DConfigPort()</code>
PortNum	AUXPORT
PortType	AUXPORT

Port I/O functions, methods, and argument values supported

UL:	<code>cbDOut()</code> , <code>cbDIn()</code>
UL for .NET:	<code>DOut()</code> , <code>DIn()</code>
PortNum	AUXPORT
DataValue	0 to 255 for AUXPORT

Bit I/O functions, methods, and argument values supported

UL:	<code>cbDBitIn()</code> , <code>cbDBitOut()</code>
UL for .NET:	<code>DBitIn()</code> , <code>DBitOut()</code>
PortType	AUXPORT
BitNum	0 to 7 on AUXPORT

Data Logging

Data logger functions and methods supported

UL:	<code>cbLogConvertFile()</code> , <code>cbLogGetAIChannelCount()</code> , <code>cbLogGetAIInfo()</code> , <code>cbLogGetCJCInfo()</code> , <code>cbLogGetDIOInfo()</code> , <code>cbLogGetFileInfo()</code> , <code>cbLogGetFileName()</code> , <code>cbLogGetPreferences()</code> , <code>cbLogGetSampleInfo()</code> , <code>cbLogReadAIChannels()</code> , <code>cbLogReadCJCChannels()</code> , <code>cbLogReadDIOChannels()</code> , <code>cbLogReadTimeTags()</code> , <code>cbLogSetPreferences()</code>
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UL for .NET:	<code>ConvertFile()</code> , <code>GetAIInfo()</code> , <code>GetAIChannelCount()</code> , <code>GetCJCInfo()</code> , <code>GetDIOInfo()</code> , <code>GetFileInfo()</code> , <code>GetFileName()</code> , <code>GetPreferences()</code> , <code>GetSampleInfo()</code> , <code>ReadAIChannels()</code> , <code>ReadCJCChannels()</code> , <code>ReadDIOChannels()</code> , <code>ReadTimeTags()</code> , <code>SetPreferences()</code>
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The `cbLogGetCJCInfo()` function and the `GetCJCInfo()` method return the number of CJC temperature channels logged in the binary file ("0" or "2").

The `cbLogGetDIOInfo()` function and the `GetDIOInfo()` method return the number of digital I/O channels logged in the binary file ("0" to "8").

Data logger argument values

Delimiter	Comma, Semicolon, Space, Tab
LoggerUnits	Temperature, Raw
Units	Celsius, Fahrenheit, Kelvin
TimeFormat	TwelveHour, TwentyFourHour
TimeZone	Local, GMT

Hardware considerations

Logging and storing measurement data

Temperature measurements can be stored onto a CompactFlash[®] memory card (64 MB CF card included with hardware). Each sample is stored on the card in a binary file. You set up your logging options through *InstaCal*:

- temperature input channels to log
- channel format as raw data or temperature
- start mode to begin a logging session
- interval (sec.) between samples
- set up alarm conditions to trigger DIO bits

InstaCal provides further options for copying, converting, and deleting the binary files. You can access log data stored on the memory card with a CompactFlash reader, or by transferring the files from *InstaCal* to a computer for processing and conversion using the USB bus.

Note: A card reader is not required to access log data on a device installed with firmware 3.0 and later. A device with this firmware version appears in Windows Explorer as a removable drive from which you can directly access the log data.

External power required for data logging

Due to processing limitations, data logging to the memory card is not allowed when the device is connected to your computer's active USB bus. When operating as a data logger, disconnect the USB cable from the computer, and connect the external power supply shipped with the device.

Note: If you are using a self-powered hub, make sure it is attached to the PC's USB port before connecting it to the USB-5201 or USB-5203. If a powered hub is connected to the device first, it may be detected by the device as a power supply and go into logging mode.

Configuring the DIO channels to generate alarms

The USB-5203 and USB-5201 both provide eight independent temperature alarms. Each alarm controls an associated digital I/O channel as an alarm output. The input to each alarm is one of the temperature input channels. Use *InstaCal* to set up the temperature conditions to activate an alarm, and the output state of the channel (active high or low) when activated.

Digital channels that are configured as alarms will power up in an output state. When an alarm is activated, the associated DIO channel is driven to the output state defined by the alarm configuration.

The alarms function both in data logging mode and while attached to the USB port on a computer. The alarm configurations are stored in non-volatile memory on the device and are loaded on power up.

Pacing temperature readings

The internal update rate for temperature measurement is a fixed value for these devices. If the UL reads the device faster than the internal update rate, temperature readings "repeat." For example, if using `cbTIn()` in a loop to measure a rapidly changing temperature, readings do not change for several iterations of the loop, then "jump" when the update occurs internally.

Using single sensors with `cbTInScan()`

When using single sensors for RTD or thermistor sensors, you should ignore the data for channels that do not have sensors attached. It is best to use `cbTIn()` for these configurations, since you can select which channels to read. If you use `cbTInScan()`, however, data for all channels over the entire range of channels are returned. Since some channels are not populated in this configuration, you should filter out the data for channels without sensors.

Saving configuration settings

InstaCal allows you to save USB-5203 and USB-5201 configuration settings to a file, or load a configuration from a previously saved file.

- Each USB-5203 channel can be configured to measure temperature data collected by one of five categories of temperature sensors: thermistors, thermocouples (one of eight types), RTDs, semiconductors, and *Disabled*.
- Each USB-5201 channel can be configured to measure temperature data collected by one of eight types of thermocouples.

Recommended warm-up time

Allow a warm-up time of 30 minutes before taking measurements. This warm-up time minimizes thermal drift and achieves the specified rated accuracy of measurements.

For RTD or thermistor measurements (USB-5203 only), this warm-up time is also required to stabilize the internal current reference.

Calibration

Any time the sensor category is changed in the configuration for the USB-5203, a calibration is automatically performed by *InstaCal*. If the device has not been warmed up when this occurs, you should re-calibrate after the specified warm-up time.

Error codes

- The UL returns *-9999* when a value is out of range or an open connection is detected.
- The UL returns *-9000* when the device is not ready. This usually occurs right after the device is powered up and calibration factors are being loaded.

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the LED on the side of the module to blink twice for visual identification.

When you have several modules connected to the computer, use these functions to identify a particular module by making its LED blink.

WEB-TEMP, WEB-TC

The WEB-TEMP and WEB-TC support the following UL and UL for .NET features.

Temperature input

Temperature input functions and methods supported

UL:	cbTIn (), cbTInScan ()
UL for .NET:	TIn (), TInScan ()

Temperature input argument values

Options	N/A
Scale	CELSIUS, FAHRENHEIT, KELVIN
HighChan	0 to 7

Digital I/O

Configuration functions, methods, and argument values supported

UL:	cbDConfigBit (), cbDConfigPort ()
UL for .NET:	DConfigBit (), DConfigPort ()
PortNum	AUXPORT
PortType	AUXPORT

Port I/O functions, methods, and argument values supported

UL:	cbDIn (), cbDOut ()
UL for .NET:	DIn (), DOut ()
PortNum	AUXPORT
DataValue	0 to 255 on AUXPORT

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn (), cbDBitOut ()
UL for .NET:	DBitIn (), DBitOut ()
PortType	AUXPORT
BitNum	0 to 7 on AUXPORT

Configuration

Configuration functions and methods supported

UL:	cbGetConfig (), cbSetConfig (), cbGetConfigString (), cbSetConfigString ()
-----	--

Configuration argument values

ConfigItem:	BINODEID, BINETIOTIMEOUT, BIHIDELOGINDLG
Device Number	0
maxConfigLen	Up to 48

Miscellaneous

UL:	cbDeviceLogin (), cbDeviceLogout (), cbFlashLED ()
UL for .NET:	DeviceLogin (), DeviceLogout (), FlashLED ()

Hardware considerations

Web based

If the user name and password have been changed from the default, the user must log in with the new user name and password to change configuration settings. Only one user can be logged in at a time. The log in session times out after five minutes of inactivity. Log in is not required to view the current configuration in *InstaCal*.

Hardware options are configurable on the web browser or with *InstaCal*. If hardware options are changed on the web browser while *InstaCal* is open, restart or refresh *InstaCal* to update its configuration pages with the settings stored on the device. Network parameters and some configuration settings for resistance measurement are configurable with *InstaCal* only.

Configuration options are stored in non-volatile memory in EEPROM, and are loaded on power up.

Network parameters

The following network parameters are configurable with *InstaCal*. Configurable network options are enabled when you start *InstaCal* if the default user name and password are still assigned. If a custom user name and password have been assigned, the configurable network options are enabled after you log in.

- **Identifier:** Text that identifies the WEB device. This value is optional, and is not set by default. You can enter up to 48 alpha-numeric characters. You can set this value in code using the Universal Library ConfigItem option BINODEID with cbSetConfigString().
- **DHCP:** Enables automatic configuration of the IP address of the WEB device by a DHCP Server. When a DHCP-enabled server is available, an IP address is automatically assigned to the device when it is detected on the network. This value is set to *Enabled* by default. Disable this option when the server is not DHCP-enabled, or when you want to enter a static IP address.
- **IP:** The IP address that is currently stored on the device is displayed in the **Current Settings** frame in *InstaCal*'s Board Configuration dialog. By default, this address is set automatically when a DHCP server is available. If you are setting a static IP address manually, enter it in the **IP** text box on the **Default Settings** frame. Every device connected to the network must have a unique IP address. This value is set to 192.168.0.101 by default.
- **Subnet:** The Subnet Mask that is currently stored on the device is displayed in the **Current Settings** frame in *InstaCal*'s **Board Configuration** dialog. The Subnet Mask is the part of the IP address that denotes the local Subnet. By default, the Subnet Mask is set automatically when a DHCP server is available. If you are setting a static IP address manually, enter the Subnet Mask in the **Subnet** text box on the **Default Settings** frame.

This value is set to 255.255.255.0 by default. The first three groups of numbers indicate the network number to which the device is connected, and the last group indicates the node number within the network that identifies the device.

- **Gateway:** The Gateway IP address that is currently stored on the device is displayed in the **Current Settings** frame in *InstaCal*'s Board Configuration dialog. By default, the Gateway IP address is set automatically when a DHCP server is available. If you are setting a static IP address manually, enter the Gateway in the **Gateway** text box on the **Default Settings** frame. This value is set to 192.168.0.1 by default. The Gateway parameter is used for communication between devices on different networks.
- **Server:** Enables or disables the device's web page server. This value is set to *Enabled* by default. When enabled, you can view the device's web page with a web browser. When disabled, you can only access the device with *InstaCal* or the Universal Library. Disable when you want to restrict access to the device's web page. Changes to this setting take affect the next time you power up the device.
- **Change Login** button: Opens a dialog to change the user name and password used to log in to a device session. Once changed, log in is required to change configurable options on the device. The user name and password are not stored on the host computer, and must be entered each time you start the application. Refer to Logging in to a device session on page 193 for more information.

- **Login** button: This button is enabled when login is required.

InstaCal's configuration page also lists the unique 64-bit physical (MAC) address assigned to the device. You cannot change this address.

Logging in to a device session

You must be logged in to a device session in order to change the configuration settings of a device or change the state of the digital outputs. A user name and password are required to log in if they are not set to the default values. For security, it is recommended that you change the login values from the defaults. The log in session times out after five minutes of inactivity.

The default user name is set to *webtemp* for the WEB-TEMP, and *webtc* for the WEB-TC. The default password is *mccdaq* for both devices. You can change these values in *InstaCal* with the **Change Login** button after you are logged in to a device session. Each value can be up to eight alphanumeric characters.

Using *InstaCal*, when the user name and password have been changed from the default values, the configuration page opens with configurable items disabled and the **Login** button enabled. Click the **Login** button and then enter the values. The `INVALIDLOGIN` error is returned if the login information is not valid. The `SESSIONINUSE` error is returned if you attempt to log in when a session is currently open by another user. Only one user can be logged in to a session at a time.

Similarly, applications written with the Universal Library will perform a background log in when required if the login parameters are set to the default values. If custom values have been set, you have the option to allow the default login dialog to pop up when required or to disable the default dialog and handle login in your code.

To disable the default login dialog when using the Universal Library, you can select the **"Show Login dialog prompt"** option in *InstaCal*, or for a more permanent result, disable the default dialog using `cbSetConfig()` with the `BIHIDELOGINDLG` `ConfigItem` argument within your application code.

Factory default reset

To restore the network parameters (including the user name and password) to the factory default settings, press and hold the device's reset button for three seconds. You do not have to be logged in to restore the default network settings.

Manually adding a device to *InstaCal*

If a device is not yet connected to the local network, or if it is connected remotely to a different LAN, *InstaCal* will be unable to detect it. If autodetection fails, you can manually add the device to *InstaCal* using the **Web** tab on the **Board Selection List** dialog, and specify the IP address and port to use in the broadcast.

The default IP address and port add a placeholder to the configuration of a WEB device detected on the network. The default IP address broadcasts to all devices detected on the local subnet. The default port lists the default port number that is used to interface with the UL.

Any instance of the device type responding to the broadcast will attach to the placeholder. You can specify the device to attach to the placeholder by clicking the **MAC** check box and entering the device's type and instance ID. Enter **C0** to locate a WEB-TC, or **C2** to locate a WEB-TEMP. Enter any value from **0x00000** to **0x2FFFE** (except **0x1FFFF**) for the instance ID. The first three octets of a MAC address indicate the vendor ID and cannot be changed.

Configuring the DIO channels to generate alarms

The WEB-TEMP and WEB-TC provide eight independent temperature alarms. Each alarm controls an associated digital I/O channel as an alarm output. The input to each alarm is one of the temperature input channels. You set up the temperature conditions to activate an alarm, and the output state of the digital channel (active high or low) when activated. You can view the alarm status on the web browser.

Digital channels that are configured as alarms will power up in an output state. When an alarm is activated, the associated DIO channel is driven to the output state defined by the alarm configuration. The alarm configurations are stored in non-volatile memory on the device and are loaded on power up. Alarm settings can be configured using the device's web browser or *InstaCal*.

Pacing temperature readings

The internal update rate for temperature measurement is a fixed value for these devices. If the UL reads the device faster than the internal update rate, temperature readings "repeat." For example, if using `cbTIn()` in a loop to measure a rapidly changing temperature, readings do not change for several iterations of the loop, then "jump" when the update occurs internally.

Using single sensors with `cbTInScan()` (WEB-TEMP only)

When using single sensors for RTD or thermistor sensors, you should ignore the data for channels that do not have sensors attached. It is best to use `cbTIn()` for these configurations, since you can select which channels to read. If you use `cbTInScan()`, however, data for all channels over the entire range of channels are returned. Since some channels are not populated in this configuration, filter out the data for channels without sensors.

Channel names

You can specify a custom name for each of the device channels with *InstaCal*. Enter up to 10 alpha-numeric characters in the **Name** text box on each channel configuration page.

Saving configuration settings

InstaCal allows you to save hardware configuration settings to a file, or load a configuration from a previously saved file.

Each WEB-TEMP channel can be configured to measure temperature data collected by one of five categories of temperature sensors: thermistors, thermocouples, RTDs, semiconductors, and *Disabled*. Each WEB-TC channel can be configured to measure temperature data collected by one of eight types of thermocouples.

Recommended warm-up time

Allow the WEB device to warm-up for 30 minutes before taking measurements. This warm-up time minimizes thermal drift and achieves the specified rated accuracy of measurements. For RTD or thermistor measurements, this warm-up time is also required to stabilize the internal current reference.

Calibration

You can manually calibrate a WEB device using *InstaCal* or the web interface. Any time a sensor is changed using the WEB interface, a calibration is automatically performed. If the device has not been warmed up when this occurs, you should re-calibrate after the specified warm-up time.

Timeout errors

In some cases, there can be delays in obtaining the data from the WEB device, causing a `NOREMOTEACK` error to be generated. This can be caused by other users making configuration changes on the device, or by slow or busy network connections.

You can use the `ConfigItem` option `BINETIOTIMEOUT` with `cbSetConfig()` to set the time (in mS) to wait for a device to acknowledge a command or query made via the network connection.

FlashLED()

Call this function to flash the POWER/COMM LED on a WEB device. This is useful if you have multiple devices connected and you want to identify a particular device.

WLS Series

The WLS-IFC, WLS-TEMP, and WLS-TC support the following UL and UL for .NET features.

Temperature input (WLS-TEMP and WLS-TC)

Temperature input functions and methods supported

UL:	cbTIn (), cbTInScan ()
UL for .NET:	TIn (), TInScan ()

Temperature input argument values

Options	N/A
Scale	CELSIUS, FAHRENHEIT, KELVIN
HighChan	0 to 7

Digital I/O (WLS-TEMP and WLS-TC)

Configuration functions, methods, and argument values supported

UL:	cbDConfigBit (), cbDConfigPort ()
UL for .NET:	DConfigBit (), DConfigPort ()
PortNum	AUXPORT
PortType	AUXPORT

Port I/O functions, methods, and argument values supported

UL:	cbDOut (), cbDIn ()
UL for .NET:	DOut (), DIn ()
PortNum	AUXPORT
DataValue	0 to 255 for AUXPORT

Bit I/O functions, methods, and argument values supported

UL:	cbDBitIn (), cbDBitOut ()
UL for .NET:	DBitIn (), DBitOut ()
PortType	AUXPORT
BitNum	0 to 7 on AUXPORT

Configuration

Configuration functions and methods supported

UL:	cbGetConfig (), cbSetConfig (), cbGetConfigString (), cbSetConfigString ()
UL for .NET:	GetDeviceNotes (), SetDeviceNotes (), GetDeviceId (), SetDeviceId (), GetPANID (), SetPANID (), GetRFChannel (), SetRFChannel (), GetRSS ()

Configuration argument values

ConfigItem:	BIRFCHANNEL, BIPANID, BINODEID, BIDEVNOTES
-------------	--

The following argument value is also valid for the WLS-TEMP and WLS-TC when they are operating as remote devices:

BIRSS

Hardware considerations

Wireless operation

You can operate the WLS-TEMP and WLS-TC as remote devices that communicate with the computer through a USB-to-wireless interface device, such as the WLS-IFC. The interface device can communicate with multiple remote WLS-Series devices over a wireless link.

Network parameters (wireless operation)

Use *InstaCal* to configure the network parameters required for wireless communication. Configuration options are stored in non-volatile memory in EEPROM, and are loaded on power up.

Network parameters can only be modified when the device is connected locally to the computer through the USB port. After configuring the network settings for a remote device, unplug from the computer and move the device to its remote location.

The following network parameters are programmable with *InstaCal*:

- **Identifier:** Text that identifies the WLS Series device. This value is optional, and is not set by default. You can enter up to 20 alpha-numeric characters.
You can set the text identifier value using the `ConfigItem` option `BINODEID` with `cbSetConfigString()` or `SetDeviceId()` while the device is connected locally to the computer through the USB port, or when the device is operating remotely.
- **PAN (hex):** The personal area network ID assigned to the device. This value is set to 1000 hex by default (4096 decimal).

Most users do not need to change this value. However, you may want to change the PAN value in the following situations:

- You have multiple WLS Series devices and do not want to allow communication between all of them. Set the PAN ID to the same value on each device that you want to communicate.
- If other WLS Series devices are operating in the vicinity, you can avoid accidental changes to your device settings by changing the default PAN value.

To change the PAN ID, enter a 16-bit hexadecimal value between 0 and FFFE. (Hexadecimal values consist of numbers between 0 and 9 and letters between A and F. In this case, up to four characters could be entered.)

You can set the PAN value using the `ConfigItem` option `BIPANID` with `cbSetConfig()` when the device is connected locally to the computer through the USB port.

- **CH:** The IEEE 802.15.4 radio frequency (RF) channel number assigned to the device. This is the channel number used to transmit and receive data over the wireless link.

The table below lists each channel available along with its corresponding transmission frequency.

RF Channel	Transmission Frequency (GHz)	RF Channel	Transmission Frequency (GHz)
12	2.410	18	2.440
13	2.415	19	2.445
14	2.420	20	2.450
15	2.425	21	2.455
16	2.430	22	2.460
17	2.435	23	2.465

The channel number is set to 16 by default. Select a different channel number if another group of WLS Series devices is already transmitting on that channel, or if the signal is spotty or intermittent, indicating noise on the channel. If you change the channel for one device, remember to also change the channel number on all other devices with which you want to communicate.

The level of noise per channel is system-dependent, and depends on the number of transmitters in the local vicinity, including wireless telephones, video monitors, and so on.

You can set the RF channel using the `ConfigItem` option `BIRFCHANNEL` with `cbSetConfig()` while the device is connected locally to the computer through the USB port.

- **AES Key:** The value used to encrypt a message (optional).

This value is disabled by default. To enable encryption, click the *AES Key* button and enter up to 16 alpha-numeric characters in the text box. This value is write-only; it cannot be read back.

Unless you suspect that there are other users of WLS Series devices in the area, there should be no need to enable encryption. However, if you suspect that there are other WLS Series devices in the area, and you need to secure the devices from being accessed by other users, enable this feature.

Note that enabling encryption does NOT secure the device from access through a local USB connection. A remote device configured for encryption can be connected locally through the USB port to access other remote WLS Series devices with the same settings; you may need to physically secure the remote devices to prevent tampering of the of device's network.

Set the PAN ID, RF channel, and AES key to the same value for each device that you want to communicate

Only devices with matching parameter settings for PAN ID, RF channel, and AES encryption (if set) can communicate with each other.

InstaCal's configuration page also lists the unique 64-bit address assigned to the device. You cannot change this address.

Use the **Device Notes** tab to enter up to 239 ASCII characters of additional text — for example, what the device is measuring, and which device it is communicating with. You can set the text to store in the device's memory using the `ConfigItem` option `BIDEVNOTES` with `cbSetConfigString()`.

Received Signal Strength (wireless operations)

When a WLS Series device is operating remotely, *InstaCal*'s configuration page includes a bar graph. The bar graph indicates the strength of the signal received by the remote device from the wireless interface module, and the fade margin of signals received by a device (refer to the following table.)

Active bars	fade margin	Rss (dBm)
0 – Weak signal	< 10 dBm	-82 dBm > rss
1 – Moderate signal	≥ 10 dBm	-72 dBm > rss ≥ -82 dBm
2 – Strong signal	≥ 20 dBm	-62 dBm > rss ≥ -72 dBm
3 – Very strong signal	≥ 30 dBm	rss > -62 dBm

The number of bars corresponds to the number of LEDs that are lit on the remote device. The bar graph display updates every two seconds on the *InstaCal* form.

If the signal is not strong enough for communication between the interface device and the remote device, no bars or LEDs show, and a `NOREMOTEACK` error is returned. If this occurs, try moving or re-orienting the device to increase the strength of the signal

You can retrieve the value in dBm of the signal strength received by a remote device using the `ConfigItem` option `BIRSS` with `cbGetConfig()`.

External power required for wireless operations

An external power supply is required to power remote devices. For wireless operations, connect the device's USB cable to the AC-to-USB power adapter that shipped with the device.

Always connect an external hub to its power supply

If you are using a hybrid hub — one that can operate in either self-powered or bus-powered mode — always connect it to its external power supply.

If you use a hub of this type without connecting to external power, communication errors may occur that could result in corrupt configuration information on the wireless device. You can restore the factory default configuration settings with *InstaCal*.

Factory default reset

To restore factory default configuration settings, click on the **Reset Defaults** button on *InstaCal*'s configuration page. The device must be connected locally to the computer's USB port to restore default settings.

Configuring the DIO channels to generate alarms (WLS-TEMP and WLS-TC)

The WLS-TEMP and WLS-TC both provide eight independent temperature alarms. Each alarm controls an associated digital I/O channel as an alarm output. The input to each alarm is one of the temperature input channels. Use *InstaCal* to set up the temperature conditions to activate an alarm, and the output state of the channel (active high or low) when activated.

Digital channels that are configured as alarms will power up in an output state. When an alarm is activated, the associated DIO channel is driven to the output state defined by the alarm configuration. The alarms function both in wireless mode and while attached to the USB port on a computer. The alarm configurations are stored in non-volatile memory on the device and are loaded on power up.

Alarm settings can be configured when the device is connected locally to the computer through the USB port, or when the device is operated remotely through a wireless interface.

Pacing temperature readings

The internal update rate for temperature measurement is a fixed value for these devices. If the UL reads the device faster than the internal update rate, temperature readings "repeat." For example, if using `cbTIn()` in a loop to measure a rapidly changing temperature, readings do not change for several iterations of the loop, then "jump" when the update occurs internally.

Using single sensors with `cbTInScan()`

When using single sensors for RTD or thermistor sensors, you should ignore the data for channels that do not have sensors attached. It is best to use `cbTIn()` for these configurations, since you can select which channels to read. If you use `cbTInScan()`, however, data for all channels over the entire range of channels are returned. Since some channels are not populated in this configuration, you should filter out the data for channels without sensors.

Saving configuration settings (WLS-TEMP and WLS-TC)

InstaCal allows you to save configuration settings to a file, or to load a configuration from a previously saved file.

- Each WLS-TEMP channel can be configured to measure temperature data collected by one of five categories of temperature sensors: thermistors, thermocouples, RTDs, semiconductors, and *Disabled*.
- Each WLS-TC channel can be configured to measure temperature data collected by one of eight types of thermocouples.

Recommended warm-up time

Allow the WLS-TEMP and WLS-TC to warm-up for 30 minutes before taking measurements. This warm-up time minimizes thermal drift and achieves the specified rated accuracy of measurements.

For RTD or thermistor measurements, this warm-up time is also required to stabilize the internal current reference.

Calibration

Any time the sensor category is changed in the configuration for the WLS-TEMP, a calibration is automatically performed by *InstaCal*. If the device has not been warmed up when this occurs, you should re-calibrate after the specified warm-up time.

Error codes

- The UL returns -9999 when a value is out of range or an open connection is detected.
- The UL returns -9000 when the device is not ready. This usually occurs right after the device is powered up and calibration factors are being loaded.
- With wireless operations, the UL returns NOREMOTEAACK when the signal is not strong enough for communication between the interface device and the remote device.

Miscellaneous functions and methods supported

UL: `cbFlashLED()`

UL for .NET: `FlashLED()`

Causes the USB LED on a Measurement Computing USB module to blink. When you have several modules connected to the computer, use these functions to identify a particular module by making its LED blink.

Other Hardware

Introduction

This chapter provides details on using communications boards in conjunction with the Universal Library and Universal Library for .NET. Boards released after the printing of this user's guide will be described in Readme files on the Universal Library disk.

COM422 Series

No library functions are supported for these boards, but *InstaCal* can be used to configure the serial protocol in conjunction with the `Set422.exe` utility. All other serial communications are handled by Windows standard serial communications handlers.

COM485 Series

The **COM485** Series board supports the UL function `cbRS485()` and the UL for .NET method `RS485()` for controlling the transmit and receive enable register. All other serial communications are handled by Windows standard serial communications handlers.

Appendix – Measurement Computing Device IDs

This appendix lists the device ID associated with each Measurement Computing hardware type. This information is returned by the BoardName and BoardNum arguments.

Board Name	Device ID	Board Name	Device ID
PCI-DAS1602/16	1	PC-CARD-DAS16/16	56
		PC-CARD-DAS16/16-AO	57
CIO-DAS6402/12	8	PC-CARD-DAS16/12	58
CIO-DAS16/M1/16	9	PC-CARD-DAS16/12-AO	59
CIO-DAS6402/16	10	PC-CARD-DAS16/330	60
PCI-DIO48H	11	PC-CARD-D24/CTR3	61
PCI-PDISO8	12	PC-CARD-DIO48	62
PCI-PDISO16	13	PCI-COM232	63
CPCI-GPIB	14	PCI-COM232/2	64
PCI-DAS1200	15	PCI-COM232/4	65
PCI-DAS1602/12	16	PCI-COM422	66
CIO-RELAY16M	17	PCI-COM422/2	67
CIO-PDMA32	18	PCI-COM485	68
CIO-DAC04/16-HS	19	PCI-COM485/2	69
PCI-DIO24H	20	ISA-MDB64	70
PCI-DIO24H/CTR3	21	MII-32	71
PCI-DIO48H/CTR15	22	MIO-32	72
PCI-DIO96H	23	MEM-8	73
PCI-CTR05	24	MEM-32	74
PCI-DAS1200Jr	25	PCI-MDB64	75
PCI-DAS1001	26	PCI-DAS1000	76
PCI-DAS1002	27	PCI-QUAD04	77
PCI-DAS1602JR_16	28	MSSR-24	78
PCI-DAS6402/16	29	PC104-MDB64	79
PCI-DAS6402/12	30	MAI-16	80
PCI-DAS16/M1	31		
PCI-DDA02/12	32	PCI-DAS4020/12	82
PCI-DDA04/12	33	PCIM-DDA06/16	83
PCI-DDA08/12	34	PCI-DIO96	84
PCI-DDA02/16	35	CPCI-DIO24H	85
PCI-DDA04/16	36	PCIM-DAS1602/16	86
PCI-DDA08/16	37	PCI-DAS3202/16	87
PCI-DAC04/12HS	38	PC104-AC5	88
PCI-DAC04/16HS	39	PCI-QUAD-AC5	89
PCI-DIO24	40	CPCI-DIO96H	90
PCI-DAS08	41	CPCI-DIO48H	91
CIO-RELAY24	42	PC-CARD-DAC08	92
CIO-RELAY32	43	PCI-DAS6023	93
PCI-INT32	44	PCI-DAS6025	94
DEMO-BOARD	45	PCI-DAS6030	95
CIO-DAS-TC	46	PCI-DAS6031	96
CIO-QUAD02	47	PCI-DAS6032	97
CIO-QUAD04	48	PCI-DAS6033	98
PCM-QUAD02	49	PCI-DAS6034	99
PCI-DAS64	50	PCI-DAS6035	100
PCI-DUAL-AC5	51	PCI-DAS6040	101
PCI-DAS-TC	52	PCI-DAS6052	102
PCI-DAS64/M1/16	53	PCI-DAS6070	103
PCI-DAS64/M2/16	54	PCI-DAS6071	104
PCI-DAS64/M3/16	55		

Board Name	Device ID	Board Name	Device ID
PCI-CTR10	110	USB-4301	174
PCI-DAS6036	111	USB-5201 (Rev. 3 fw and later)	175
PCI-DAC6702	112	USB-5203 (Rev. 3 fw and later)	176
PCI-DAC6703	113	USB-2523	177
		USB-2527	178
PCI-CTR20HD	116	USB-2533	179
miniLAB 1008	117	USB-2537	180
PMD-1024LS	118	WLS-IFC	181
PCI-DIO24/LP	119	WLS-TC	182
PCI-DAS6013	120	WLS-TEMP	183
PCI-DAS6014	121	USB-4302	184
USB-1208LS, PMD-1208LS	122	USB-4303	185
PCIM-DAS16JR/16	123	USB-4304	186
		USB-TC-AI	187
USB-1608FS, PMD-1608FS	125	USB-TEMP-AI	188
PCI-DIO24/S	126	USB-1608HS	189
USB-1024HLS, PMD-1024HLS	127		
6K-EXP16	128	WEB-TC	192
USB-1616FS	129		
USB-1208FS, PMD-1208FS	130	WEB-TEMP	194
USB-1096HFS	131		
Switch & Sense 8/8	132	USB-1616HS	203
USB-SSR24	133	USB-1616HS-2	204
USB-SSR08	134	USB-1616HS-4	205
E-PDISO16	137	USB-1616HS-BNC	217
USB-ERB24	138	PCle-DIO96H	218
USB-ERB08	139	PCle-DIO24	219
USB-PDISO8	140		
USB-TEMP	141		
		CIO-DAS16	257
USB-TC	144	CIO-DAS16/F	258
		CIO-DAS16/Jr	259
USB-DIO96H	146	CIO-DAS16/330	260
USB-DIO24/37	147	CIO-DAS16/330i	261
USB-DIO24H/37	148	CIO-DAS16/M1	262
USB-DIO96H/50	149	PC104-DAS16Jr/12	263
USB-PDISO8/50	150	PC104-DAS16Jr/16	264
USB-5203 (< Rev. 3 fw)	151	CIO-DAS16/Jr16	265
USB-5201 (< Rev. 3 fw)	152		
USB-1608HS-2AO	153	CIO-SSH16	513
USB-3101	154		
USB-3102	155	CIO-EXP16	769
USB-3103	156	CIO-EXP32	770
USB-3104	157	CIO-EXP-GP	771
USB-3105	158	CIO-EXP-RTD	772
USB-3106	159	CIO-EXP-BRIDGE	773
USB-1408FS	161	CIO-DIO24	1025
USB-3110	162	CIO-DIO24H	1026
USB-3112	163	CIO-DIO48	1027
USB-3114	164	CIO-DIO96	1028
PCI-2511	165	CIO-DIO192	1029
PCI-2513	166	CIO-DIO24/CTR3	1030
PCI-2515	167	CIO-DIO48H	1031
PCI-2517	168	CIO-DUAL-AC5	1032

Board Name	Device ID	Board Name	Device ID
CIO-DI48	1033	CIO-DAS1601/12	3585
CIO-DO48H	1034	CIO-DAS1602/12	3586
CIO-DI96	1035	CIO-DAS1602/16	3587
CIO-DO96H	1036	CIO-DAS1401/12	3588
CIO-DI192	1037	CIO-DAS1402/12	3589
CIO-DO192H	1038	CIO-DAS1402/16	3590
CIO-DO24DD	1039		
CIO-DO48DD	1040	MEGA-FIFO	3841
PC104-DIO48	1041	CIO-RELAY16	4097
PC104-DI48	1042	CIO-RELAY08	4098
PC104-DO48H	1043	CIO-RELAY16/M	4099
		CIO-DAS-TEMP	4353
CIO-PDMA16	1281		
CIO-DAC02	1537	CIO-DISO48	8193
CIO-DAC08	1538		
CIO-DAC16	1539	CIO-INT32	12289
CIO-DAC16I	1540		
CIO-DAC08I	1541	PCM-DAS08	16385
		PCM-D24/CTR3	16386
PC104-DAC06	1543	PCM-DAC02	16387
CIO-DDA06/12	1793	PCM-COM422	16388
CIO-DDA06/16	1794	PCM-COM485	16389
CIO-DDA06/Jr	1795	PCM-DAS16D/12	16390
CIO-DAC02/16	1796	PCM-DAS16S/12	16391
CIO-DAC08/16	1797	PCM-DAS16D/16	16392
CIO-DAC16/16	1798	PCM-DAS16S/16	16393
CIO-DDA06Jr/16	1799	PCM-DAS16S/330	16394
		PCM-DAS16D/12AO	16395
CIO-CTR05	2049		
CIO-CTR10	2050	PCM-DAC08	16401
CIO-CTR10-HD	2051		
CIO-CTR20-HD	2052	CIO-COM422	20481
PC104-CTR10-HD	2053	CIO-COM485	20482
		CIO-DUAL422	20483
CIO-PDISO8	2305		
CIO-PDISO16	2306	CIO-DAS800	24577
PC104-PDISO8	2307	CIO-DAS801	24578
		CIO-DAS802	24579
CIO-DAC04/12-HS	2564		
		CIO-DAS802/16	24580
PPIO-DIO24H	2817		
PPIO-AI08	2818		
PPIO-CTR06	2819		
CIO-DAS08	3073		
CIO-DAS08PGL	3074		
CIO-DAS08PGH	3075		
CIO-DAS08/AOL	3076		
CIO-DAS08/AOH	3077		
CIO-DAS08PGM	3078		
CIO-DAS08/AOM	3079		
CIO-DAS08/Jr	3080		
PC104-DAS08	3081		
CIO-DAS08Jr/16	3082		
CIO-DAS48PGA	3329		

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